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The Institute of Vitreous Enamellers

The Welsh Engineers' and Founders' Association

and

The Foundry Trades' Equipment and Supplies Association

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Gates and Risers

The last few issues of THE FOUNDRY TRADE JOURNAL have provided a veritable symposium on the subject of runners and risers. Obviously there has been a certain amount of restatement of fact and advice, but this is helpful rather than detrimental to the student of such matters. We cannot help but feel, however, that the whole subject could eventually be reduced to a science. We have in mind a mathematical study of moulding and casting by Mr. J. Pillon, which was presented as a French Exchange Paper to the Institute of British Foundrymen a few years ago, and we believe that a similar piece of work dealing with runners and risers would be of considerable value—a value which again would be enhanced by examples of practical interpretation. We are cognisant of the very great number of variables which enter into the subject, the most important of which are the shape, volume, section, area, depth of the mould cavity; temperature, freezing range, contraction, life and density of the metal; and refractoriness, permeability, elasticity and heat conductivity of the core and mould materials. This involves three main variables, and probably a dozen ancillary ones; but in spite of these and the fact that there are "several ways of killing a cat," we feel that a mathematical study would be helpful.

Constants could be achieved by making experiments with die castings, which would eliminate most of the variables in connection with mould materials. The metal used for casting, too, could be standardised, whilst the shape of the mould could be variable. When exact knowledge had been gained from these desiderata, then the metal could be varied as to casting temperature, density and freezing range, and the essential alterations in the runners and gates noted. The final study would be with sand moulds, the properties of the various materials being logically altered and the effects noted. At the moment, apart from the postulation of a number of common-sense rules, the successful production of castings is dependent upon the accumulated experience of generations of high-grade craftsmen. In a few cases this information has been garnered, classified and filed for use by the executive staff, yet its interpretation is still so difficult that decisions are invariably made by one or several persons of proved practical ability. This system should, at least in theory, make for reliability in production, yet at best it is merely the application of a collection of empiricisms. Something more is obviously needed, as even under the best of controlled conditions a new design of casting is tried out more or less experimentally. Usually it is successful, owing to the operation of the *experientia docet* factor, but conditions should be such that certainty of initial successful production is established on a mathematical basis. Many decades will pass before this ambition is achieved, but the more data available—and the industry is indeed grateful to those who have already given so readily of their experience—the earlier will this element of risk be removed.

Turn of the Tide

If evidence had been needed that the prices of the non-ferrous metals, copper, tin, spelter and lead, were being supported in the face of a deteriorating statistical position this was provided in the coming of the Easter holiday, when consumers' interest declined to a marked extent and quotations fell on the Metal Exchange. Quickly following this hint of a weakening tendency there came, however, an expression of opinion by the President of the United States that durable commodities had been lifted to an unreasonably high level, in connection with which he cited copper and steel as outstanding examples. Mr. Roosevelt went further than this, for he made it fairly obvious that it was his government's intention to concentrate on schemes which would lead to the use of consumer goods in preference to the durable articles. As usual, the President rather denounced "big business," and one cannot help having a certain amount of sympathy, at any rate with the copper producers, who had to a large extent made a high price level through speculative activity on the London market.

The American President's pronouncement upset the equilibrium of the London Metal Exchange, and some panicky selling followed which brought about a sharp setback in quotations. For some long time past knowledgeable people have been convinced that the price of all the non-ferrous metals, and, perhaps, particularly copper, was too high, and the reaction of the base metals to Mr. Roosevelt's remarks showed, as it were, the existence of a guilty conscience in some directions. Producers were the first to deplore the excessive speculation which so quickly forced values up to a high level, for they could see more clearly than anyone the inevitable effect upon output, which, encouraged by the prospect of enormous profits, was certain to advance quickly. In many instances the turn of the tide has probably come too late, for new mines have already been opened up, and properties which were closed for many years because the price level was unremunerative have been put into commission again.

Progress of the Birmingham Branch

A year of successful activity under the Presidency of Mr. G. W. Brown was reviewed on April 2, at the annual meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, held at the James Watt Memorial Institute, Birmingham.

The hon. secretary, Mr. A. A. Timmins, presented the report which stated that during the session six meetings had been held at which a wide variety of subjects was discussed. It was disappointing therefore to find that, except on the occasion of Mr. J. G. Pearce's lecture on "Principles of Cast Iron Metallurgy," the average attendance at meetings was below 50, compared with 54 in the previous year. This was no doubt due to busier foundry conditions making it difficult for members to attend. Despite the comparatively small attendance, however, the discussions had been excellent. In October a party of members visited London as guests of the London Branch at a joint conference. The conference was a great success and left little doubt that such gatherings would do much to further the interests of the Institute. There had been two works visits, one in the early part of the session when a party of members inspected the Austin Motor Works at Longbridge, and the other to the Parkinson Stove Company, Limited, Stechford. A new venture was the holding of the annual dinner and dance at the Botanical Gardens, Edgbaston. This was highly successful, a record attendance of 196 members and ladies being present. The principal guests were Lord Austin of Longbridge, Mr. E. J. Fox, the President of the Institute (Mr. H. Winterton), and the general secretary (Mr. T. Makemson). Two Past-Presidents also attended. There had been a satisfactory improvement in the number of members, 44 new members having been elected, or transferred from other Branches. The total membership now stood at 305. The number of subscribing firms was 7, compared with 3 last year. Ten members had either resigned or transferred to other Branches. Expenditure had been rather higher than in previous years, but notwithstanding this there was a balance in hand of £44 10s. The subscription income at the end of last year was practically the same as in the previous year, due to the fact that there were rather more subscriptions outstanding, and also because the majority of the new members had been elected since January 1, 1936. The report was adopted and Mr. Timmins was complimented and warmly thanked for his services.

Mr. H. J. Roe was then appointed Branch-President and took the chair. Mr. G. W. Brown, who proposed his election, said that over a long period of years Mr. Roe had shown a deep interest in the Institute's welfare.

Mr. G. W. Callaghan, in seconding the motion, said that when, many years ago, Mr. Roe was hon. secretary of the Branch he discharged all the duties with the greatest credit, and he was certain that he would make an excellent President.

Other appointments were:—*Senior Vice-President*: Mr. W. J. Molineux; *Junior Vice-President*: Mr. L. W. Bolton; *members of Branch Council to serve for three years*: Mr. J. W. Gardom, Mr. W. L. Johnston, Mr. A. Tipper and Mr. N. C. Blyth; *member of Branch Council to serve for one year*: Mr. T. H. Gameson; *delegates to General Council*: Mr. W. J. Molineux, Mr. D. H. Wood, and Mr. G. T. Lunt; *delegates to Technical Committee*: Mr. L. W. Bolton and Mr. G. R. Shotton; *auditors*: Mr. W. L. Johnston and Mr. J. Callaghan; *hon. sec. and treasurer*: Mr. A. A. Timmins.

The Branch-President proposed the re-appointment of Mr. Timmins. Mr. D. H. Wood, who seconded, said this would be the third year that Mr. Timmins has acted as secretary, prior to which he was assistant secretary for two years. The amount of work to be done had increased enormously, even in the last year, and they were grateful to Mr. Timmins for his ability and enthusiasm in carrying out all the duties of the office. Mr. Timmins said he was more than compensated by the appreciation and support of members.

Mr. F. J. Cook, in expressing thanks to the retiring officers, said there would be general agreement that they had had a very happy and successful year under the presidency of Mr. Brown, a fact which was reflected in the large increase of membership.

Mr. G. W. Brown spoke of the loyal and co-operative support accorded to him during his term of office, remarking that if the interest and enthusiasm shown in recent years could be maintained both the Branch and the Institute must benefit.

On the conclusion of the business there was a short Paper competition. The Papers were read by Mr. E. T. Austin, and Mr. J. Dearden's Paper entitled "Factors Affecting the Ramming Density of Sand" was awarded the prize.

The Derby Conference Fund

In connection with the annual conference of the Institute of British Foundrymen, which is to be held in Derby from June 8 to 11, the hon. conference treasurer, Mr. S. H. Russell, of Bath Lane, Leicester, acknowledges with gratitude the receipt or promise of following subscriptions to the conference fund:—

	£	s.	d.
Qualcast, Limited	50	0	0
Ley's Malleable Castings Company, Limited	30	0	0
Herbert Morris, Limited	21	0	0
S. Russell & Sons, Limited	20	0	0
Ashwell & Nesbit, Limited	10	10	0
The Fordath Engineering Company, Limited	10	10	0
Gimson & Company (Leicester), Limited	10	10	0
Rolls-Royce, Limited	10	10	0
William Spiers, Limited	10	10	0
Aiton & Company, Limited	10	10	0
British Pigirons, Limited	5	5	0
British United Shoe Machinery Company, Limited	5	5	0
The Carborundum Company, Limited	5	5	0
James Durrans & Sons, Limited ...	5	5	0
Mr. W. T. Evans	5	5	0
Mr. Alex Hammond	5	5	0
J. W. Jackman & Company, Limited	5	5	0
J. & W. K. Birkinshaw	3	3	0
The Foundry & Engineering Company (West Bromwich), Limited	3	3	0
Goodwin, Barsby & Company, Limited	3	3	0
Leicester and District Ironfounders Employers' Association	3	3	0
Richards (Leicester), Limited ...	3	3	0
Mr. H. Bunting	2	2	0
Haslam Foundry & Engineering Company, Limited	2	2	0
G. Potter & Sons	2	2	0
Mr. Thos. Goodwin	2	0	0
Precision Presswork Company ...	2	0	0
Mr. H. J. Beck	1	1	0
Joseph Boam, Limited	1	1	0
A. W. Brook, Limited	1	1	0
Mr. R. H. Buckland	1	1	0
Mr. J. Carruthers	1	1	0
Midland Furnace Lining Company ...	1	1	0
Taylor & Hubbard, Limited	1	1	0
Amounts under £1	5	15	0
	£259	18	0

Random Shots

The oldest casting and the largest casting have ever been topics of great interest and constant argument amongst foundrymen, and now to these, it seems, can be added the "Tallest story about castings." Mr. Longden, in a recent Paper, quoted a Jules Verne story of a cannon. Here it is, with Mr. Longden's introduction and comment:

* * *

Speaking of drop gates, no doubt many foundrymen were fascinated in their youth by the wit and fancy of Jules Verne (d. 1905), as evidenced in his stories. Among them was "A Voyage from the Earth to the Moon." This versatile Frenchman required a cast-iron cannon to enable him to propel his heroes to the moon in a suitable projectile. He saw no insuperable difficulty in the way of making, in suitable ground, a cylindrical mould 900 ft. deep, 21 ft. outside dia., with a 9 ft. dia. core running from bottom to top. In the story the mould was safely cast by emptying into it the contents of 1,200 reverberatory furnaces, having an aggregate capacity of some 60,000 tons. The metal from each furnace, tapped at the same moment as the others, ran 600 yds. along a gutter, then falling over the lip of the mould into its 900 ft. drop. Any foundryman who has had to cast on end jobs of 20 ft. or more would probably find his hair standing on end if he were asked to cast one 900 ft. deep. It is quite sure that, outside the pages of a novel, the metal would reach the end of its 900 ft. drop with a deuce of a thump, and that the only projectile ever likely to come out of such a cannon would be the core, which, during the pour, would go part of the way to the moon.

* * *

Mr. E. V. Lucas, in his "Highways and Byeways of Sussex," tells us of an itinerant founder of the 18th century who used to cast new bells for the village churches. His method was to collect the metal locally, build a fire, and dig a mould in a nearby field. A friend, well versed in foundry matters, to whom this was read as a probable point of interest to him, merely remarked "Oh yeah?"

* * *

This next is not a tall story of a casting, but a story of a tall casting. From China comes the news that highly-skilled workmen in the sacred mountain of Kiuhwashan are engaged in the casting of the largest bell in the world. It is to be known as the "Bell of Hell," and it will be rung to help the souls of Buddhists in hell to find their way towards salvation.

* * *

A member of the Costing Sub-committee seems a little worried lest last week's reference to meetings on board a yacht should convey a wrong impression of their very serious intentions. "Marksman" would hasten to remind him that it's the exceptional event which "gets in the news," and consequently the many Saturday afternoons spent in deep discussion naturally pass without comment.

* * *

Incidentally, with the approach of the annual conference in Derby, followed almost immediately by one in Paris, that particular committee could well do their fellow members a good turn by estimating for them how much it will cost in beer to attend both. Paris in June is a very thirsty place and exhibitions always produce a peculiar dry feeling in the throat.

* * *

It appears that the young lady who went to Belgium with the London Branch recently was a negress. The whole matter seems to be a very shady affair, and further investigations ought to be made. Could it be that she was a native of the Belgian Congo?

"Marksman."

Mechanical Aids for Increasing Foundry Production*

By JAMES TIMBRELL

Many foundries at the present time are extremely busy; in some cases pressure is so great that refusal of further business is the rule, unless delivery dates can be extended to the point where these are possible. Such a position is very gratifying to all who are connected with the production and sale of castings. What steps can be taken to increase output have been discussed from many angles. Skilled labour is in great demand, and there is no surplus of reliable all-round men at the moment. Whilst overtime will sometimes ease the situation, it is expensive and does not always give the return that is desired.

It is reasonable to assume that this period of heavy requirements will pass, and for that reason it is advisable to explore the possibilities of a re-arrangement of existing routine and to introduce methods and mechanical help to release skilled productive labour from other than

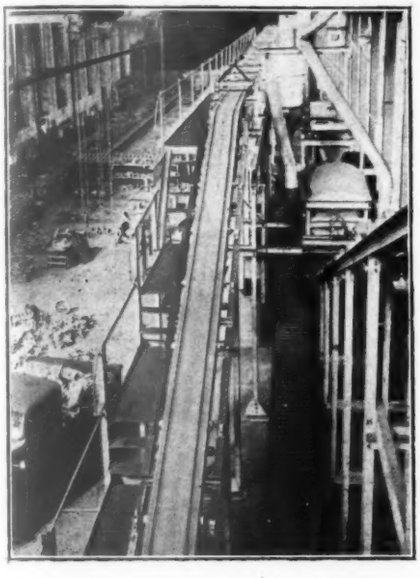


Fig. 1.—Sand Preparing and Handling Plant in a Continuous Casting Bay.

productive duties. This line is a good one to take before any new extensions are decided, particularly if these additions are to be planned and run on the existing older style of routine.

Very often the introduction of mechanical aids into the older type of moulding shop can be effected without much serious upheaval or disturbance, to give a marked increase in production, with better control, and to pay for themselves over a period. There are not many executive foundrymen who have not read descriptive articles about mechanised plants, where hand labour has been reduced to small proportions. Some of these continuous moulding and casting lay-outs are built round standard every-day repetition castings, such as high-class cylinder blocks and baths.

To apply such mechanisation to a foundry where orders are small, and the work is of a jobbing nature, would neither be wise nor profitable. There are, however, certain parts and units that might be introduced into many of the older style shops with every confidence and profitable advantage, if it be realised that the bulk of the equipment of any mechanised foundry is for sand preparation, delivery and return, mould carrying and casting—in brief, sand and castings. Either or both of these offer the same scope in most shops, and make the question of mechanical aids easier to plan.

Fig. 1 shows a sand preparation and handling plant applied to a continuous-casting bay, where the castings are in great variety and weigh from a few pounds to 3 or 4 cwts., and the moulding boxes are in about the same variety as many other semi-skilled and skilled moulding shops. Previous to this installation, each man or gang mixed the sand to their own standards and the job in hand. It will be seen that by doing this work for the men, that time becomes available for production of moulds, and where, say, 20 producers now do this themselves every day regularly, the loss in productive time is considerable. Where foundry plant, such as this installation, is designed well above its likely requirements, there is no question of its efficiency, or any machine or floor not being supplied with all that is required. To apply sand mixing and delivery on a less ambitious scale in an existing shop requires consideration of one or two points in planning, and may be commenced in a simple form at first, with an eye on the possibilities of adding other units as circumstances permit.

Fig. 2 will perhaps convey the idea more fully. It shows a large-size mixer, with hopper underneath, distributor plate and belt conveyor. The idea can be applied in many cases where sand is still milled and delivered in the old way. The belt need not be above eight feet from the floor, as height is only necessary where hoppers or shutes are over benches or machines. The pull-down ploughs will shute off the sand into bins or floor heaps, as required. However, even with this simple form, sand return from the floors has to be considered, and will be mentioned again later; but assuming that only this part of the scheme is put in first, there are two ways of providing return sand as a temporary measure.

One suggestion is that, if sufficient floor space is available, each producer be allowed enough room for two floors side by side, so that he can work them on alternate days. The advantage is that he will open his boxes as required, leaving the castings and sand to be handled by the shop labour. Another suggestion is to have an early squad to get out castings and heap the used sand at the end of the floors to be removed as required for the sand mixer. There is something to be said for even these simple arrangements, and they have virtues which may be compared with large storage hoppers. With storage hoppers to which sand is returned from different classes of work, the sand naturally varies in heat, moisture and condition. With the heaped sand more time is allowed for cooling, and when fed into the elevator bucket the condition of the sand is more easily observed. This minor criticism in no sense suggests that a hopper is not the quicker and more easily operated unit.

Fig. 3 shows a storage hopper for the returned sand from the knock-out. The sand has been passed through a rotary sieve, where it has had the dust or silt extracted from it by a cyclone, the metal and sprigs, etc., have been removed by passing over a magnetic roller, and it is distributed evenly by an arrangement at the top. All controls of the mixer can be worked from the platform, water measuring meter, elevator bucket for the new sand, the discharge doors open into a receiving hopper and the sand shaved off by an adjustable blade on to the delivery belt. Such large storage of sand, where it varies in quality, when shot direct into the mixer should be churned over a few seconds to observe its nature, previous to adding the new sand and water, as any excess over 5 per cent. of moisture is liable to give trouble in certain classes of work.

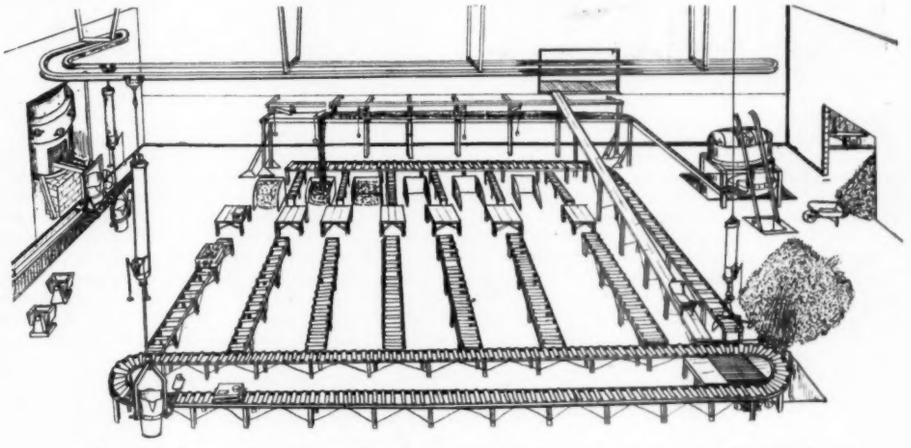


Fig. 2.—Roller Conveyors Used to Link the Sand Belt with the Casting Rail.

A moisture indicator is a valuable tool and the few minutes taken to ascertain the moisture content are well spent. There is the chance, then, if an excess is found, to deliver this batch to a less important floor or work of a heavier nature.

Considering the second means of increasing the output by mechanical means, casting offers plenty of scope for development. It is often said that the best man for casting is the one who made the moulds, but with the correct equipment pouring can be better controlled with less over-metal teemed.

Fig. 4 shows a method of casting which, compared with later practice, appears rather wasteful of labour, but 17 years ago was considered much in advance of the previous practice for shanking light and medium castings. It certainly has quick service, and, being on overhead easy-running equipment direct to the metal delivery rail, distribution was carried out with very little loss of temperature. This method required two delivery men and two men to each shank, plus skimmers. Comparison with Fig. 5 is illuminating, as this shows a type of casting ladle which is controllable by one man. It will carry up to about 4 cwts., which is very near

* A Paper read before the Lancashire Branch of the Institute of British Foundrymen, Mr. J. Hogg presiding.

the limit without some form of safety gearing. This is made largely possible by the use of light-gauge section sheet iron, rolled into shape and welded up. Balance was most troublesome to arrive at, but after several attempts it was brought about by making the ladle rather top heavy when empty. When full it has to be held back for pouring and when about half empty requires light pressure.

Fig. 6 shows the ladle in more detail. The ring is just a little below the centre line, safety

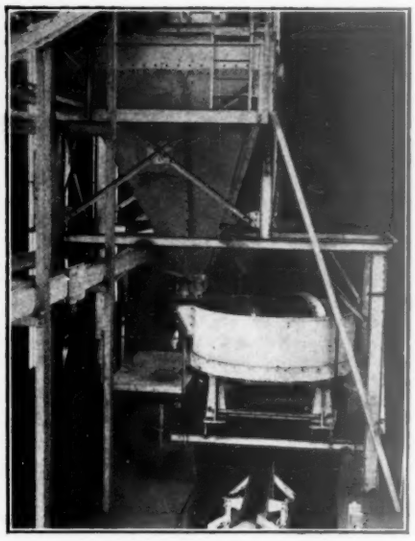


Fig. 3.—Storage Hopper for Used Sand.

Fig. 4.—Old-Fashioned Casting Method, involving Labour Wastage.

Fig. 5.—Casting Ladle of 4 cwt. capacity Controllable by One Man.

catch and lever. The asbestos scabbard protects the hand and the skimmer plate is worthy of note. These plates are of ordinary cast iron, daubed up with ladle sand and fixed separately. After the ladle is dried it can only be used for one day's run. A three-ply template developed for shape in a dried ladle will give the outline for making the pattern, and when the skimmer

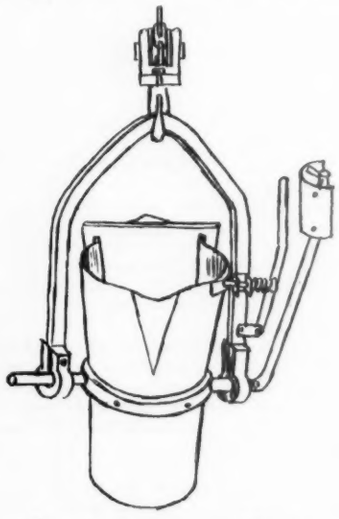


Fig. 6.—Details of Modern Ladle.

plates are fixed the ladle becomes a tea-pot pourer.

Fig. 7 shows the number of parts required and how these are built up. Two pieces of thin-gauge metal sheet are rolled to give a slight taper. The lip pieces are cut away, and two shaped ones welded on. The figure also shows a slightly thicker bottom plate; the brass bearings and the skimmer plate. It is best to use nuts and bolts for the ring, and then the balance can be altered if any undue effort has to be used when pouring, because, being single handed, any pressure put on has a tendency to swing the ladle out, as it is suspended from an easy runner on a single line overhead. The lightest work can be cast cleanly and quickly, and two operatives have handy 8 to 10 tons of metal regularly as required in a semi-continuous casting bay. These ladles must be kept clean and raked out occasionally, and all over-metal can be emptied into permanent tip-up moulds placed conveniently along the casting line.

To make the best use of this type of ladle, the air hoist is eminently satisfactory. It has a very slow up-and-down movement when required, which is a valuable feature. A slight movement of the control rod will give a slow upward creep and keep the ladle lip just above the bush. As to maintenance, these ladles run indefinitely without much attention. Restriction of movement from one end of the line to the other is overcome by the use of snap-on couplings. A loop in the air pipe will give a fair amount of travel, controlled by the height of the overhead rail, but to cover a long shop from cupola spout to the end of the casting conveyor, one or two extra points are needed. These clip-on couplings act as valves, and on release do not waste the air pressure but automatically seal the pipe; the valve on the air hoist does the same. This keeps the ladle in suspension, and it can then be moved to the next point along the line and attached again to the air supply in that particular quarter.

Linking Sand Belt and Casting Rail

Lengths of roller conveyor will connect these together as shown in Fig. 2. Instead of moulding on the floor for double-handed boxes, a roller conveyor replaces it. Carrier plates will be needed and moulds works on these from either moulding machines, benches or floors. After the moulds are cored up, closed, clamped and bushed, etc., they are pushed along on to the conveyor rail for casting. This brings the cast moulds in line to a part of the shop which can be used for knocking them out and despatching the castings to the fettling end, and incidentally brings the sand nearer to its starting point. It may be advantageous at some future date to instal a knock-out grate and maybe a belt to return this sand to the heap or storage hopper for heavy boxes, and there are one or two types of slings or grab chains attached to an air hoist for lifting these heavier boxes from the casting rail on to the grate.

A roller conveyor was installed to speed up the cast-up box delivery to the knock-out grate and used alongside a slow-moving power-driven mould conveyor, because, during any casting period, the conveyor had to be controlled to suit this, and this alone. When stationary during the actual pouring, moulds were put on at the various points to travel round in turn for pouring. This side roller conveyor can be filled up and the boxes dealt with as quickly or as slowly as the grate can accommodate them.

To compare power-driven mould conveyors with roller conveyors, the latter have much in their favour. The following considerations arise with the power-driven type: For pouring, it is out of the question to pour when this is moving unless some provision is made for making the ladle and runner move at the same speed as the conveyor. With boxes of varying weight and size, it may pass the knock-out too slowly or too fast, and if the boxes come too rapidly, they have to go past and make another circuit, which may take an hour or more. There is, also, the fact that they take up room which may be otherwise wanted. The knock-out operatives have to keep one eye on the caster before starting the power conveyor on the move to bring along more boxes.

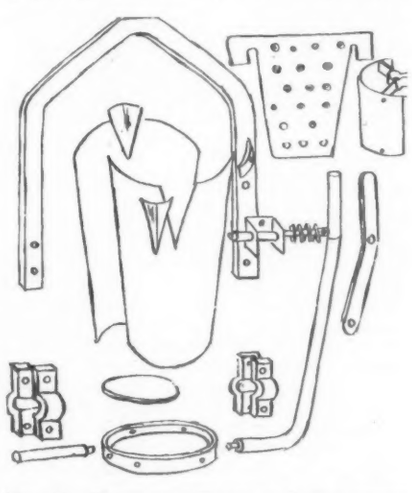


Fig. 7.—Component Parts of Ladle shown in Fig. 6.

Fig. 8 shows a view of the supplementary roller conveyor mentioned above, and with this type every move that is required can be made

complete in itself and independent of the other related parts. Moulds which require special irons can be shunted along at the appropriate time when this iron is available. It is generally agreed in planning for mechanised foundries that when the knock-out and casting work smoothly, without congestion at either end, the success of the lay-out is largely assured, and these two points constitute a fair part of the problem.

One more advantage under certain conditions is that rollers can be placed to take advantage of gravity, and a slight slope to the knock-out

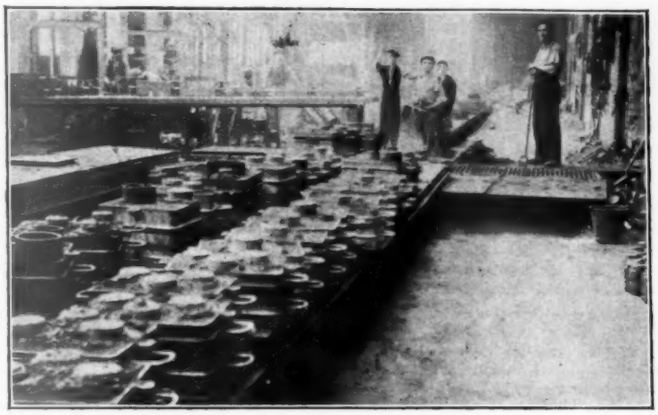


Fig. 8.—Supplementary Roller-Conveyor to Speed up Delivery of Cast Moulds to the Knock-Out Grate.

and box return will keep these two from being stalled.

As one other development of the knock-out to deal with sand castings and scrap, etc., Fig. 9 shows a grate swivelled at one end and at the other, on columns, a jolt cylinder to shake out the boxes. The sand falls down the shute on to a sand thrower, and so to the heap near the mixer elevator-bucket. Boxes are put on to gravity rollers and returned to the respective floors. Castings may be put in the barrow or other conveyance and taken away. The scrap is put into the tub on the rail to go back to the cupola stage and odds and ends of core sand put into a tub. The air hoist, if the roof be fairly high, may be hung on a second swivel, and

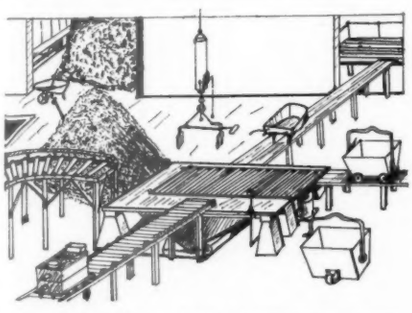


Fig. 9.—Knock-Out Department with Swivelling Grate.

the swing will cover the roller conveyor ends. This arrangement will keep the grate and roundabout tolerably free from jamming.

To conclude, most of the policy outlined is based on a daily output of 8 to 10 tons per day with a cupola about 23 in. dia. operating for 4 to 6 hours' casting run.

Vote of Thanks

Mr. H. V. Grundy, in proposing a vote of thanks to Mr. Timbrell for his Paper, said the author had spoken of casting ordinary jobbing work rather than repetition work. He had stated that it was quite easy to shunt special work until such time as special metal became available. What arrangement was made in regard to the conveyor to feed that special work if and when it was necessary? Apparently, something more was required than the ordinary shunting method.

He did not know how long Mr. Timbrell had had compressed air hoists in operation, but, in his (the speaker's) experience, compressed air hoists were not altogether suitable for this purpose. It was difficult to prevent air leakages, and compressed air was expensive in the case of a scheme which was in operation over a large area. What was Mr. Timbrell's experience in regard to the overcoming of air leakages? In the case of a hoist with a cylinder about 4 ft. 6 in. or 5 ft. long, and the necessary piston rod, much headroom was essential. In his opinion, electric hoists were preferable in this connection.

Mr. A. Phillips seconded the vote of thanks. Mechanised plants, he said, should certainly be adopted more than they were, and then it would be possible to ascertain more fully their disadvantages. With regard to the air hoist in connection with the air supply, if one was to take metal from the cupola, run it along the telpher, and then to the position on the conveyor, he could not understand how Mr. Timbrell got his air supply quickly connected to it.

DISCUSSION

Mr. Timbrell, referring to the shunting of moulds requiring the special iron, said that anything up to 3 or 4 different kinds were used during the day, and such moulds were left on the rollers for a period and then pushed along. Leakages from air hoists could usually be overcome by attention, and he had seen ladles taken from the spout right to the other end of the shop without any loss of air. The only parts that could leak were either the packing gland or the valves, but if these were in good condition, they should not leak.

In his experience there was nothing that gave a better control than the air hoists for light work. This might be because of the light-weight ladle he used. Probably electrical power would be cheaper than compressed air, but he thought that much of the wastage on air hoists was unnecessary. If all that was required was to lift a 6 cwt. load, it would be a mistake to buy an air hoist which would lift, say, 3 or 4 tons capacity, although, of course, it was necessary to instal one which could do its job efficiently. Air hoists would probably be as economical as electric hoists, if maintenance were taken into consideration.

Hand feeding, in the case of a mechanised shop, was eliminated by the use of chills or other methods.

Compressed Air Ramming

Mr. J. Masters said he would be glad to have Mr. Timbrell's views upon the use of compressed air rammers in a general jobbing shop. He had had the privilege recently of visiting a foundry which adopted methods somewhat different from those described by the lecturer. Where Mr. Timbrell had his weights lifted on by hand, there was an air hoist for every mould that went on the conveyor. This particular firm must have had about twenty air hoists suspended immediately over the casting platform. The moulder never touched the mould, but cast in a manner similar to that indicated by Mr. Timbrell. Upon inquiring of the manager what the increased output was, after spending so much money, the information was vouchsafed that it had risen from 20 tons per week to 40 tons of castings per week. There was a sand-conditioning plant, and, he thought, they made their own compressed air hoists. Apparently, the outlay justified its expenditure. He would like Mr. Timbrell to state any details he could in connection with other equipment, irrespective of mechanical casting devices.

Mechanising a Small Jobbing Shop

Mr. Timbrell remarked that most of the devices he had referred to were used in a mechanised shop. In the particular case he had in mind there were six moulding machines, including two jar-ram rollovers, two table squeezers, and two of ordinary jar type. There was certainly a quantity of machine moulding and he had endeavoured to select the best of that, and see if it could be applied to a little shop where the men still mixed their own sand. The moulds from the moulding machines, etc., all went to the conveyor, and in the case of a small shop he thought it would be possible to do with much less labour, and get more work done, by having roller conveyors and sand supplied to them.

There was great scope for pneumatic rammers, in any foundry, but they had their limitation, and moulding machines were certainly quicker. They were not always suitable, however, for small jobbing work if customers supplied their own patterns.

Sandslinger Application

Mr. Phillips said the Sandslinger had not been introduced into the discussion, although for jobbing shops a well-placed Sandslinger appeared to be about as good a mechanical aid as was possible.

Moisture Control

Mr. Grundy inquired what kind of a moisture tester Mr. Timbrell used, and what guarantee had he that it indicated the moisture of the whole of the pile of sand?

Mr. Timbrell said that the moisture content of sand was one of the difficulties in a jobbing shop where varying qualities of sand were returned. The only course to be taken was that of observation in the mill as sand was turned over. The moisture tester was mentioned when referring to the amount of water added to the sand, and was applied when the sand was knocked out from the moulds.

Mr. Grundy thought Mr. Timbrell was referring to one of the immersion appliances which were merely pushed into a pile of sand, to indicate the moisture content.

Mr. Timbrell said that he had in mind either the Speedy moisture meter or the usual laboratory method.

Mr. J. Masters inquired whether it would be feasible to test the bulk of sand for its water content before it went into the mill by such an instrument as the Speedy moisture tester. It was quite common in some foundries to test the sand before it was reconditioned. He did not think there was any plant made which would give really definite control of sand until it was known what had been mixed. By taking an average sample before it went into the mixer

a very reasonable idea could be formed of what would be required to conform to standard, say 5 or 6 per cent. of moisture, according to the class of work.

Natural Moisture Preferred

Mr. J. Jackson said moisture content of sands was a particularly important problem, and had proved troublesome. Recently he had been concerned with the installation of a new sand mixing apparatus, having a water meter to control the amount of water applied to the sand. The results were not fully satisfactory, even when a measured quantity was applied, however carefully this water was added. He had found in different batches of sand the moisture content varied from 3½ to 6 per cent., this being tested with the Speedy moisture tester.

These difficulties had been overcome by the method indicated by Mr. Masters. Tests were taken of the bulk quantities of black sand, before the screening operation; as a result, the workman operating the machine was enabled to form a fair judgment of the moisture which the sand contained.

The practice of adding water into the mill was discontinued, and because of this, the new red sand, or other sand added, which had not been through the screening operation, was charged in a fairly wet condition compared with the new sand, as delivered to the works. It might be said that red sand was usually delivered in about three grades: "moist," "very wet," "a little less wet" and so on. At one time, due to this, all deliveries of new red sand were dried very carefully to remove this excess moisture, care being taken not to get it too dry.

He thought that it was generally understood that black sand, passing through the screening plant and into a hopper container, must be in a fairly dry condition, otherwise it would stick and clog in the hopper. It must certainly be in a drier condition than had to be used for moulding purposes, otherwise it would not pass through the sand cleaning apparatus in the correct way. He was obtaining very good results by this method. The men were of the opinion there was a finer bonding effect on the old sand by this method, than had been obtained by adding water in the mill. The Speedy moisture tester was used, and by checking with this, he obtained a measure of the moisture content, which could be kept very regular.

Drying Sand Deprecated

Mr. Masters thought it was a great mistake to dry any red sand. One firm he knew bought as much as 2,000 or 3,000 tons, usually in the driest season. They did not leave it exposed to the weather, and in many instances the new sand could be put through a sieve without difficulty. To dry sand was to kill the natural properties for which it was purchased. If an ordinary red sand was heated up to 100 deg. C., the alumina content would be seriously affected. The firm he was referring to kept their sand in sheds which were not exposed to the weather, and used it from the driest end. In his opinion, this was by far the best method to adopt, and much more economical than drying by any artificial means.

Mechanised Plants Need Dried Sand

Mr. Phillips could not agree with Mr. Jackson, for the reason that in some conveyor plants it appeared to be rather expensive to increase the moisture content with the addition of new sand. It was necessary to increase the moisture content by the addition of water. It was, however, quite right to bring up the moisture content with the addition of new sand for facing sand.

Some sands needed a higher moisture content than others. In the case of some of the sands Mr. Timbrell would have to use in special jobs, probably 50 per cent. more moisture would be required to make a bond than would be necessary in the case of other jobs. The Richardson moisture tester, which functioned electrically, had means by which the moisture content could be registered, yet, in his opinion, the most successful practice was to have a suitable man on the plant who could control moisture by touch.

Synthetic Sands Advocated

Mr. F. A. Harper observed that the discussion on moisture content rather strengthened the case for the proprietary bonding materials which were increasingly being introduced into repetition shops. Mr. Timbrell had mentioned a 16 in. by 14 in. box; he assumed that the plant eliminated a tremendous amount of man power, but the box first had to be lifted from the moulding machine on to the conveyor. Did Mr. Timbrell consider 16 in. by 14 in. was as heavy a box as a man could be expected to handle?

Weight of Box is to be Kept Low

Mr. Timbrell replied that he did not. That size had merely been mentioned as illustrative, yet suitable; there were some double-handed boxes up to 26 in. by 18 in. One of the advantages of rollers was that men could stand on each side and could occupy the best position for lifting. There were few mechanised shops where boxes were not hand lifted from the machine to the roller or the machine to the plate.

Mr. Harper remarked that that was not exactly what he had meant. There was, he believed, an economic limit in size, and the use of very much larger boxes would not necessarily result in any greater output than by working with 16 in. by 14 in. boxes.

Mr. Timbrell thought it was often an economy to put one job in a box instead of two, although the box was large; it was probably nearly as quick. It depended upon the circumstances.

Handling Propositions

Mr. Phillips said that when one used a box over 2 ft. square and 6 in. deep, it was necessary to use mechanical means to lift it.

Mr. Timbrell produced a print showing some boxes 24 in. square by 6 in. deep which were of a special type. Some boxes which were being used at the present day could be picked up empty by a man with one hand.

Mr. Masters said that if the moulding machine and conveyor were of similar height, the man then simply slid the box along. If he happened to be handling a box which would take four men to lift it, he used an electric lift.

Mr. Phillips: Why not an air hoist?

Space Saving

Mr. J. E. Cooke remarked that, when considering the introduction of labour saving devices into foundries, particularly a conveyor system, one consideration was the amount of space occupied. In view of the space-per-man factor, what was Mr. Timbrell's experience? Was the space per man increased by the installation of a conveyor system, or was it reduced? He had always had certain doubt about this point before the visit of the Branch to a southern works. It was surprising to find there that one conveyor was superimposed on another, which resulted in an economy of space. Nevertheless, he was uncertain whether the layouts which had been illustrated would definitely bring about a space economy.

Fewer Boxes and Less Sand

Mr. Timbrell said a great deal could be said both for and against the view advanced by Mr. Cooke. It was probable, however, that by using a roller conveyor, and starting casting at 10 o'clock in the morning, as was the practice in most shops, fewer boxes would be required, as well as less room and less sand. Mechanisation did really effect economy of space and materials. If a dozen boxes could be made and cast in one round, then a dozen would serve; otherwise perhaps 50 or 60 would be required. The conveyors he had in mind were of three sizes, approximately 14, 18 and 24 in. wide, and they could therefore deal with various widths of boxes.

Efficient Hand Labour

Mr. J. Hogg (Branch-President) remarked that Mr. Timbrell's idea in presenting his Paper was evidently to convey some idea of how to run a small shop on mechanised lines. It was surprising to find what different methods were adopted in order to economise space, labour and plant. He had seen a system of casting adopted whereby a man and a boy had occupied a space of a few square yards, and yet they had produced 60 or 70 light castings per day, one in each box, and the man had only ten boxes. There was neither a special conveying plant nor a special method used; six boxes were rammed, and the casting was continuous. When the six boxes were cast, he moulded the other four, and the boy began to get up the six boxes.

The Facing Sand Problem

One of the chief difficulties he had noticed in repetition moulding was the application of facing sand. When men were working on a machine they riddled in a certain amount of prepared facing sand, but when troughs were a foot deep it was difficult to cover the pattern with facing sand, and it was difficult to obtain a smooth face on the casting. Could Mr. Timbrell suggest a method for achieving that result? Did he prepare his floor sand to the same extent as his facing sand?

One Quality of Sand Used

Mr. Timbrell said that facing sand was not used in a mechanised shop. The quality of the sand was varied according to the job. It was all facing or backing sand, whichever term was the more suitable, and a good finish was obtained by adding either plumbago or extra coal-dust. A batch of "heavy" sand, for instance, could not be used on light work, and a certain amount of organising experience was required in order to shunt a particular sand to the particular job. Generally speaking, mechanised plants did not use facing sand, though an improved finish was not always obtained on the casting, as this depended upon the weight and the mass of the job.

Cool Sand Essential

Mr. Masters inquired if it was customary to make all the sand into facing sand as the deterioration of the sand after a cast, when only facing sand was used, was very small. He knew of one firm who added very little coal-dust or other material, and their castings were satisfactory. The sand was very well aerated and it was essential to obtain a cool sand for the job.

The Chairman asked if Mr. Timbrell knew of any method of feeding the sand from the knocked-out boxes.

Mr. Timbrell replied that the Royer machine would be satisfactory to handle it. If it were desired to throw it in bulk, a platform should be erected so that it could then be shovelled and not thrown up.

Provision of Special Sand

Mr. Phillips inquired whether it would be better to have all the sand as facing and backing sand combined, with the exception of just a small proportion of special sand to use near the runners, where a danger of fusion occurred. Apart from that, the whole of the sand should be facing sand; if this were not so, the system of a mechanised plant would be broken.

Mr. Timbrell replied that it could be done by having a small skip of special sand.

Non-Rhythmic Work

Mr. A. Jackson (Accrington) said that a certain amount of work which craftsmen did could actually be done by unskilled labour. There was a common foundry saying: "The more a man puts down the more he has to pick up." Foundry executives should devise means to save

(*Concluded on page* 292.)

Practical Notes for Moulders*

By J. PATTISON

It has been stated that when making castings there are certain basic requirements which must be given every attention and careful thought; these are: (1) The sand used; (2) the type of pattern; (3) satisfactory metal, and (4) good moulders. Neither the sand nor the pattern will be considered in this Paper.

Ramming the Mould

Ramming the mould is not quite so important in dry sand as in green sand, for the latter must be evenly rammed, and must also be of the right lightness. More latitude is allowable in ramming dry sand, although this is better hard than soft on all parts except a bottom face. The bottom face of a mould is quite hard enough if the facing is trodden down; it must not be flat rammed even on deep jobs. The points of greatest strain on a deep job, that is, the points where the metal is most likely to break through the mould walls, are the bottom corners, and to prevent any mishaps pieces of pig-iron, grids, or plates are rammed in at these points (Fig. 1). It has been found that the bottom corners of a deep job cannot be rammed too hard. Tight ramming is also advocated on the side walls of the mould and on the top part, for it is much harder to finish a soft rammed mould. Excessively hard ramming is not implied, although even shallow dry sand jobs have been rammed very hard without suffering any defects. It is, however, not the best practice.

Method of Running

The positions of the runners are very important. For medium and heavy work it has been found best to run the metal in the thick part and at the bottom, and for the metal to have, as far as possible, an uninterrupted passage especially in a complicated casting. In lighter work it is not always advisable to run the casting on a thick section, because on this class of work, the sand near the thick section is heated, whilst that at the thinner section is comparatively cold. The result is that the cooler sand helps to cool the thinner section quickly and the warmer sand helps to keep warm the part of the casting which should be cooled more quickly; but this does not apply to a large casting.

On medium and large work it is preferable to have the in-gate slightly larger than the down-gate or at least not smaller than the down-gate. If it is made smaller it tends to cause a squirting action as the metal enters the mould and can only cause trouble. An in-gate ought not to be placed under a face to be machined. A large plate casting should be run quickly with many runners in order to cover the surface as quickly as possible, for this is the type of casting which is most likely to scab. With a mould which has a large surface of metal against the top part, there is a tendency for the top to be pulled in; especially is this so if it is a green-sand job. This action is best remedied by closing the risers and so forcing the air to leave the mould by the vents and not through the risers. Closing the risers is good practice when a dry-sand mould has been burnt and all the nature has gone out of the sand as so frequently happens, for the entrapped air in this case acts as a cushion.

It is not advisable to place a runner in such a position on the mould that the metal constantly runs over a part of the mould and leaves it dry (Fig. 2). Some smaller plates are cast uphill partly for this reason (Fig. 3). In this way some metal is always at the runner end, and scabbing, which would otherwise occur, is prevented.

Venting

The green-sand mould needs more careful venting than dry-sand work. For instance, needle wiring is unnecessary in dry-sand except in very intricate parts. For a dry-sand job, even if it has a large surface at the bottom, it is only necessary to vent (with a $\frac{3}{8}$-in. wire) the black sand which is about $1\frac{1}{8}$ or $1\frac{1}{4}$ in. from the metal. It is advisable to vent down the side of the pattern, however, although in a shallow job this is only done to help the drying of the mould. In a deep job venting should be carried out in layers about 30 in. apart, and each row

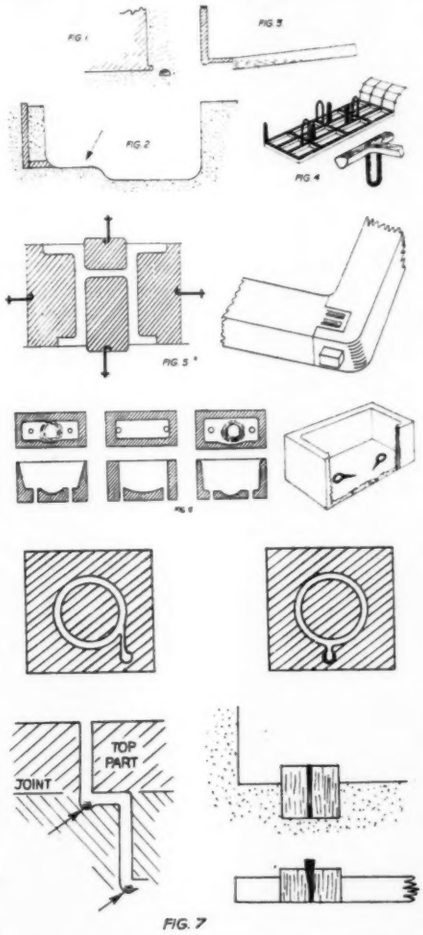


FIG. 7

of vents is brought away by a bed of cinders. Personal views on venting are only applicable if the mould is thoroughly dry. Should any moisture be present, the hot metal will change this to steam, and in so doing will increase its volume by 1,728 times and thereby cause scabs. A cinder bed should be at least 6 in. away from the mould face. It is always advisable to bring the gases away from a core at the top if possible, for when air is heated it expands and rises and it will leave the mould more freely at the top. In a 7-ton casting with which the author is familiar most of the vents came from the bottom, and all the cores were bolted through the bottom boxes. The crane lifted the boxes and the moulder cut out of the bed a channel to lead out all air, but after the air had gone the metal followed the same course. This could have been prevented if the channel had been filled with cinders.

Finishing the Mould

It is preferable to leave the sand face just as stripped, and to eliminate the use of the trowel before wet-blacking. It is, however, dangerous to postulate that sleeking the mould face before blacking is bad practice, because some moulders almost polish the sand and have no scabs. Yet it can be stated that there is more chance of scabbing when the sand is sleeked, because it tends to close up the pores. It has often been said that to wash the mould over with water, before applying the blacking, leaves the clay on the surface and generally closes the pores, but this has not been confirmed in practice. On certain jobs, it is good practice to wash over with water each section of large dry-sand moulds as they are finished, and the resultant casting will be as near perfect as possible. Large moulds are never adversely affected by washing if the water is allowed to soak in before the blacking is applied. The water brush certainly leaves the mould face suitable for the blacking to be sleeked in well, and the theory has been put forward that the water soaks in and, when it is dried out, it leaves spaces which facilitate the escape of air.

Many journeymen use clay-water when finishing the top part, but it is suggested that clay-water is unnecessary except in special cases, because plain water gives quite sufficient bond. Clay has the tendency to form a face which will not allow the air to escape easily. For finishing the top, the author does not advocate the use of sprigs, neither does he use them in a corner which has lifted well. The only place where a sprig is necessary on a dry-sand top is a broken part, and possibly where the metal flows in if it be a shallow job.

Core-Prints

In large and medium work the moulder should allow a clearance on the core-print, so that the core will enter the print easily without the moulder having to rub down the core. It is far easier to take sand off a mould before it is dry than off a dried core, besides which, when rubbing a large core—a dirty and dusty job—one is liable to rub part of the core which will be in contact with the metals, and so alter the dimension of the casting. It is usually found that if no clearance be made and the core is tight for the print when the core is lifted out, part of the mould is broken, and has to be made up. A clearance of, say, $\frac{1}{16}$ in. all round the core which has to be made up, is much more difficult than a $\frac{1}{4}$-in. gap. It may be argued that if a moulder takes a clearance off the print, he has no means of setting the core; yet on large work a print should not be utilised for this purpose, and other means, such as gauges, must be used. All cores requiring to be rubbed should be reported to the coreshop as a complaint.

For lifting cores and grids three hooks are to be preferred to four, provided the weight to be lifted is not excessive. It is, of course, necessary in some cases to have four hooks, or even more (Fig. 4).

Holding-Down Cores

The mould should be kept free from studs, chaplets and springers if possible, and it is far better to fasten a core by means of a hook bolt through a print than to use any of these (Fig. 5). Studs, chaplets and springs are a source of weakness, and if the casting has to withstand a water test, it is liabe to leak at the spot where any of these are used. In many moulds, of course, these are the only methods.

Runner Basins

Runner basins are a very important part of the mould and sometimes the sand round the gate is left with a sharp corner instead of a

* A Paper read before the Junior Section of the Lancashire Branch of the Institute of British Foundrymen.

rounded one. The bush ought to be large enough to enable it to be kept full, for if it is small the metal goes directly down the gates together with all kinds of foreign matter, whereas if it is larger a reservoir of metal is formed on the top of which all the unwanted slag and dirt floats. If the down-gates are too near the side of the bush, dirt enters the casting, but if placed centrally the metal in the bush begins to swirl and carries with it the dross. To prevent the swirling action, the stoppers or plugs may be left floating over the down-runner and they will also retain the slag. Various types of runners are shown in Figs. 6 and 7.

On larger castings it is advisable to cut a trickler to the down-runner. This allows the metal to pour slowly whilst the stoppers are still on, and when these are removed the small amount of metal already in the mould acts as a cushion and to some extent lessens the splashing inside the mould.

Design of Castings

A casting should, as far as possible, be uniform in thickness. If a heavy section of metal adjoins a thin section, the thin section will contract first and absorb all the liquid metal it requires. The thick section, however, freezes later, and since the thinner sections have solidified there is insufficient molten metal to fill the cavity, and consequently a heavy section may be of a spongy texture. If there is any appreciable difference in the section thickness, unsoundness, cracking, or internal weakness occurs, the last of which might not become apparent until the casting is in commission.

Denseners are used to try to induce the different sections to cool equally, but their use entails much guesswork as it is difficult to determine the size and thickness of the denseners required to accomplish the task correctly. Denseners equalise cooling rates because they are made of metal which is a better conductor of heat than the sand of which the rest of the mould is made. They are, therefore, placed against the thick sections from which they can conduct the heat more quickly. If a densener is too large, there may be undue hardening, as it acts as a chill.

Mechanical Aids for Increasing Foundry Production

(*Concluded from page* 290.)

the back of the craftsman, to enable him to use his greater intelligence better, as well as save him from the effects of heat. Two considerations in a foundry were the strength of the men and the sapping of vitality by heat. The greater the weight which a man had to lift the slower would be his speed, and the greater the heat the longer he would take on his job.

In foundries there were a number of moulders and a number of labourers, the former, he considered from Mr. Timbrell's remarks, were skilled craftsmen. When mechanical appliances were used, what was the ratio between moulders and labourers as compared with former conditions? In addition, the services of a certain number of mechanics would appear to be necessary.

Full Utilisation of Skill

Mr. Timbrell said that in the case of a mechanised shop, even if it was a jobbing shop, there was a considerable saving in unskilled labour, and certainly skilled labour was utilised to the full. Pneumatic rammers were certainly very useful, but he had not seen a successful peening one. The majority he had seen had round-faced noses. They appeared to work very quickly, but perhaps they did not ram quite so well as those with a flat nose.

Pneumatic Runners

Mr. Masters thought that the shape of the rammer end was immaterial; it could be adjusted to any required purpose, either by wood,

(*Concluded in next column.*)

A Novelty and a Moulding Test

Whilst the moulding of a cup, saucer and spoon as a single unit will never be a commercial proposition, it may appeal to some firms as an advertising novelty, as showing the running properties of their metal, its surface finish or as proof of an ability of their iron to take a finish such as a vitreous enamel. The job may be done in any standard set of boxes, providing the middle part is about the depth of the cup.

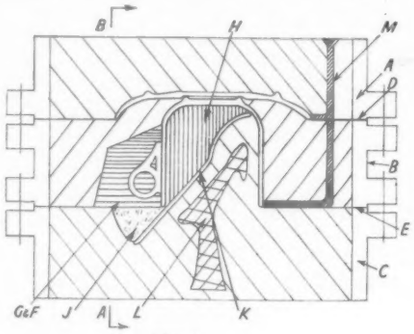
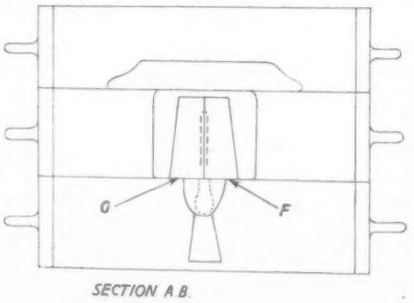


FIG. 1.

Fig. 1 is a cross section through the mould, showing the side of the handle of the cup, and Fig. 2 gives another view through the mould at right angles to Fig. 1. It is not advisable, if attempting the job, to use an expensive tea set, because it is easily broken in the operation; moreover, the china ones are rather thin. Pottery articles are to be preferred, being thicker and consequently more easily run.



SECTION A.B.

FIG. 2.

The moulding operations are as follow:—Place box "A" on to a turn-over board, put the saucer in this upside down and ram up. Turn over and make the joint "D." It is also advisable to ram up in this part a runner down-right peg "M." Now place the cup on the saucer, the right way up, put the middle-part box on "B" and ram up, making the joint "E" at the top of the cup. Then ram in the down-gate peg. Cut out from this rammed up middle, portions "G" and "F," taking care to give plenty of taper or draft; well paper the sides or trowel on damped dry-sand, the former being preferable. This is to form the parting joint. Ram up portion "G," which includes the hole in the handle, using well-toughened sand. The joint here must be made down the centre of the handle, and the vertical joint face must be papered. This will prove to be a tedious job, and it is advisable to have a piece of wood about ¼ in. thick—the shape of the vertical joint—to act as a resistance whilst ramming. Now portion "F" may be rammed up; this is not so difficult, but good sand must be used. The joint "E" may now be repaired where the incision has been made. Next place the spoon "K" in the cup; any position will do to suit the requirements, but in the diagram it is shown over the cup handle. Ram up portion "H," and make the joint up to the top of the spoon, as shown by the differently shaded portions. This joint again must be papered or damped dry-sanded as before. Next place a thin layer of sand on this joint and fix the lifter "L." This will be easy if made from wood cut roughly to the shape shown. Form the piece of sand shown at "J," as it will be seen that the spoon at this point is undercut. Place on box "C" and ram up. Lifting it off will enable the spoon to be withdrawn, whilst portion "J" will remain down on joint "E"; this is clearly shown on the diagram. Before replacing box "C," it is necessary to clay-wash or otherwise gum the joint along the line of the spoon, so that the portion "H" will more readily overcome the fluid pressure when being cast. This is very important, for, after the cup is taken out, the portion "H" has really no bottom, and is able to float. Replace box "C," and turn over all three box parts, being very careful to make sure no undue jarring takes place when doing this. It is advisable to clamp the three parts firmly together. Lift off part "A" and withdraw the saucer. Form the in-gate from downgate "M" to the edge of the saucer in part "A," then lift off box "B." It will be noticed that portions "G" and "F" and the cup will remain down on joint "E" if the work has been done properly. Then form the in-gate to the cup as shown. The two in-gates are then arranged from down-gate "M," and this will ensure a run up, as the contact between the saucer and cup may not be too wide and might cause a short run. It is necessary to use a very fluid iron for such a job. Loosen the cup a little and give it a twist away from the portion "G," which is forming the hole in the handle. This will split the vertical joint down the handle, and move portion "F," which should be moved about ¾ in. The cup is now free to be withdrawn. Replace portion "F" with the trowel into exactly the same position; if this is not done, a crushed and a spoilt job will ensue. After replacing box parts "B" and "A," put about a ½ cwt. weight on the top box before pouring. The operation should take a good moulder about two hours.

(*Concluded from previous column.*)

rubber lining, or leather. One of the largest foundries in the Lancashire district did not use peg rammers at all; they used the pneumatic type, and it was certainly a big asset in the foundry for speeding up production, and the men preferred it. Most of the work was done in dry sand or was skin dried work. The liability of scabs was considerably reduced by drying or skin drying.

A Better Sand Wanted

Mr. E. Flower said he wished to refer most particularly to an attempt to evolve a sand which would be applicable to a sand conveyor system, and which would be applicable also to the casting of steel castings. He did not experience any difficulty with regard to evolving a sand to withstand the high temperature of steel but this was inadequate.

Mr. Timbrell regretted that he could not give any information on this subject as his experience had been solely with sand for cast iron.

British Steelwork Association

At an extraordinary general meeting, held on March 23, of the British Steelwork Association (limited by guarantee), it was resolved that the Association be wound up voluntarily. Mr. R. M. Peat, of Peat, Marwick, Mitchell & Company, was appointed liquidator. After payment of all liabilities and the costs of winding-up, the liquidator was authorised to pay over the residue of the assets of the Association to the British Constructional Steelwork Association for the use of the Propaganda Committee of that Association.

Gates and Risers on Small Non-Ferrous Castings*

By J. M. DOUGLAS

In this Paper it is proposed to deal with three series of alloys, namely, gunmetal, brasses and some nickel alloys. An attempt will be made to give an account of the theory governing the gating of these alloys rather than to describe isolated examples of special gating; such gating, after all, follows from first principles applied by the ingenious foundryman. The examples given are nearly all simple castings designed to show the application of a principle or method. The author would emphasise, however, that any principles laid down have been proved in practice and are not deducted solely from the examples shown.

A Popular Type of Gate

For non-ferrous alloys, where the gate has to feed the casting, the type shown in Fig. 1 is the ideal form to use. Most moulders use this type of gate through precedent, and there are sound technical reasons behind its adoption. Thus, in conjunction with the high specific gravity of the alloys dealt with, the large gates used would lead the metal to enter the mould with such force that probably some damage would result. The horizontal runner is provided to control the stream and lead it more gently into the mould. The swelling seen at the bottom of the downgate is useful in this respect, as the bottom part fills with metal, forming a cushion against the descending stream.

Due also to the large size, it is difficult to choke the gate, and this is not usually attempted in small castings. The pouring basin shown is merely furnished to provide a large target for the pourer and to lead the metal into the downgate with as little turbulence as possible.

It should be understood that the foregoing remarks refer mainly to green-sand castings; with dry-sand, this type of gate, although desirable, is not so necessary, and gates may be dropped straight on to the casting, observing only the usual precautions as in other branches of foundry work. It is considered, however, that it is owing to the general use of this type of gate that the brass foundry is so comparatively free from sand troubles, despite the fact that, due to the high finish demanded on its castings, the green sand used is often of a finer, but weaker, quality than that in the iron foundry.

With non-ferrous alloys in general, the casting temperature is much more intimately bound up with gating methods than with the ferrous alloys, and this is so particularly evident with gunmetal that few statements on its gating can be authoritative without an accompanying description of the temperature of casting. It is mainly from this angle that the subject of gating small gunmetal castings has been approached.

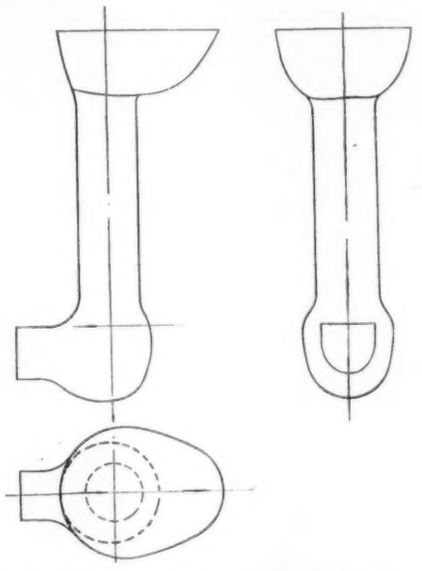


Fig. 1.—Gate for Non-ferrous Castings where Gate has to Feed the Casting.

Gunmetal Gating

In the manufacture of small castings it is sound practice, both technically and economically, to have the gate to feed as well as run the casting, and in this connection the next consideration is the most important one, namely, the size or section of the gate in relation to the section of the casting and the influence of casting temperature on this relationship.

The foregoing description of the shape of gate to be used represents an ideal, but although it is held to be the best, it would be wrong to say that it is the only form of gate which can give sound castings; on the other hand, if the size of gate is not in correct ratio to the size of casting, the result will inevitably be defective. In small gunmetal castings the effect of section of gate is very much more important than the effect of hydrostatic pressure.

The nature of the defects caused by improper gating fall into two classes:—(1) Defects due to (*a*) damage to the mould, such as scabs, and (*b*) cold shuts, solid contraction cracks, blown holes, etc.; (2) shrinkage defects. It is not proposed to deal with the first class, as the defects in it are common to most branches of founding, and the remedies the same for all. The defects in the second class are, however, more peculiar to gunmetal.

By the nature of the constitution of the alloy, the shrinkage is interdendritic, but this again can give two classes of defect, namely:—(1) A localised shrinkage defect; and (2) an interspersed shrinkage defect.

The first classification, "localised shrinkage defect," as its name implies, is concentrated at various parts of the casting. It is usually located in the form of a "hot tear" or "sink" at the junction of light and heavy sections, or where a gate or riser joins the casting.

The second type, the "interspersed shrinkage defect," is found mostly in heavy sections and is almost invariably associated with a high casting temperature. It is never discernible on the outside of a casting and only in severe cases can it be seen even on a machined surface. Usually it is detected by hydraulic test or density determination and can be recognised on a fracture. Its prevalence is affected by the conditions of the metal melting and effect of impurities such as phosphorus, but that does not come within the scope of this Paper.

Effect of Size of Gate and Casting Temperature on Shrinkage

It has been found from practice that the following generalisations can be made:—

(1) Large gates give sound castings over the whole range of casting temperature.

(2) Medium-sized gates give sound castings at higher temperatures and unsound castings at lower temperatures.

(3) Small gates give unsound castings at the higher temperatures and may give sound castings at lower temperatures.

As the casting temperature range of gunmetal is fairly short—over the whole series the inclusive limits are approximately 1,080 to 1,220 deg. C.—it follows that for mass or semi-mass production work, where a large number of small boxes have to be cast from the one crucible, the gates must be designed to come under the first category, namely, large gates to give sound castings over the whole range of casting temperature. To satisfy this the runner must have the same or slightly larger section than the casting.

Fig. 2 shows a spray of valve face castings in an alloy of 85 per cent. copper, 8 per cent. tin, 3.5 per cent zinc and 3.5 per cent. lead. About 30 boxes of these are cast at a time from a

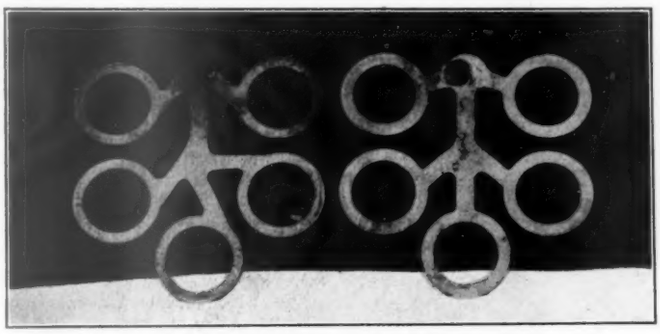


Fig. 2.—Spray of Valve Face Castings. The Spray on the Left is designed to overcome Sand-hole Defects.

Fig. 3.—Admiralty Gunmetal Castings with Medium-sized and Small Gates. The Two on the Left were Cast at 1,220 deg. C., whilst those on the Right were Cast at 1,080 deg. C.

* A Paper read before the Scottish Branch of the Institute of British Foundrymen, Mr. Frank Hudson presiding.

200-lb. crucible, and it is often found that, in doing so, the metal temperature decreases over the whole casting range. In no case, however, is there any trouble due to shrinkage defects in this design. The only trouble experienced is due to sand holes, and the spray on the left shows a gate designed to overcome this. The metal enters tangentially and the runner is widened at the point of entrance in order to reduce the force of the metal stream. At the same time the sharp corners are taken out by means of fillets on the pattern plate.

The castings shown in Fig. 3 are designed to illustrate the second and third methods, that is the medium-sized and the small gates. The

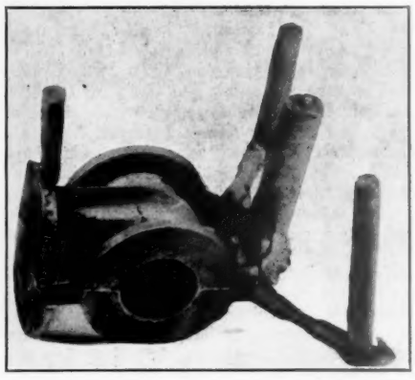


Fig. 4.—Gunmetal Sluice Valve.

alloy in this case is 88:10:2 Admiralty gunmetal. Each casting is a cylinder 4 in. deep by 4 in. in diameter. The larger gate seen here is insufficient to feed the casting over the whole range of casting temperature, but it gives a sound casting at the upper limit and shows a "sink" at the lower limit. The results from the smaller gate are completely reversed. After this photograph was taken the castings were sectioned and the only defect found to be present was the sink, as seen.

The obvious conclusion from this would seem to be that the third method, *i.e.*, the use of small gate and low casting temperature, is the best from the point of view of fettling costs and metal economy. In actual practice, however, the results are uncertain, and it is not recommended except for what might be termed problem castings. The adjustment of temperature and sized gates and casting temperature in the upper limit of the range is recommended. Castings with varying sections should be gated where possible on the heaviest part, and where light sections intervene separate runners or gates should be provided as far as possible for each heavy part.

A Sluice Valve Casting

The casting shown in Fig. 4 is a gunmetal sluice valve. The two flanges are the heaviest sections and accordingly two heavy runners are used. This design can be obtained sound at temperatures from 1,120 to 1,200 deg. C. To obtain specified results from the test-bar, however, the temperature must be limited to between 1,120 and 1,160 deg. C. The test-bar is the standard I.B.F. design applied to a cast-on bar.

The casting on the right of Fig. 5 is the standard I.B.F. loose test-bar, and can be taken as an example of sound gating methods. The casting on the left is a block test-bar for use where the top part of the box is too deep to allow the usual riser being used. It can also give satisfactory results, but extra work is involved in dressing and machining.

Influence of Casting Temperature on Gating

Admittedly the following explanation is conjecture, but it is based on the observation of such facts as tin-sweat or segregation, density determinations, test-bar results and general casting phenomena. Fig. 6 shows three diagrams of the cylindrical castings already described. The top one represents the cylinder cast at a low temperature with a medium gate. It is obvious that here the gate has set before the casting, cutting off feeding metal and causing the sink to form at the point of final solidification. This has been termed "localised shrinkage defect."

The middle diagram represents the casting with the same gate, cast at a higher temperature. It is certain that this gate must also have set before the casting, and yet the casting is quite sound. The suggested explanation is that the shrinkage has been neutralised by an occlusion of gas from the metal as it solidifies, causing an internal pressure, the gas remaining trapped between the dendrites. This gives rise to the condition previously spoken of as "interspersed shrinkage defect." The cross shading in the centre shows the probable extent of these gas inclusions.

It does not follow that the casting will be defective due to this, as the cavities formed are microscopically small so that only a density test will determine their presence. It is only when

The third casting has been cast at the same temperature as the first, but it is sound. The explanation is that the time of pouring has been increased by the small gate to such an extent that, aided by the low casting temperature, progressive solidification must have taken place. Following this last example to its logical conclusion, it would appear to be possible to obtain

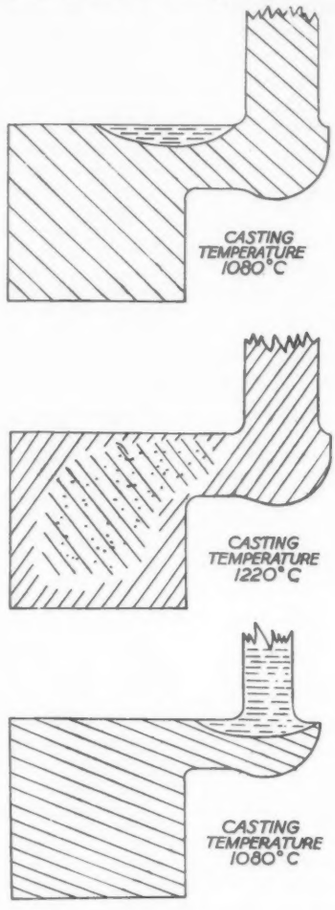


Fig. 6.—Effect of Temperature and Gate Size on Cylindrical Castings.

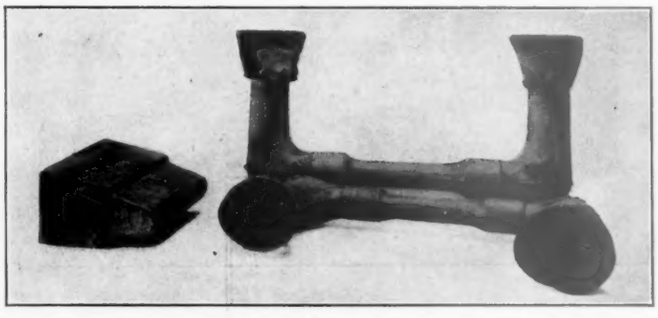


Fig. 5.—On the Left is a Block Test-bar, and on the Right the Standard I.B.F. Loose Test-bar.

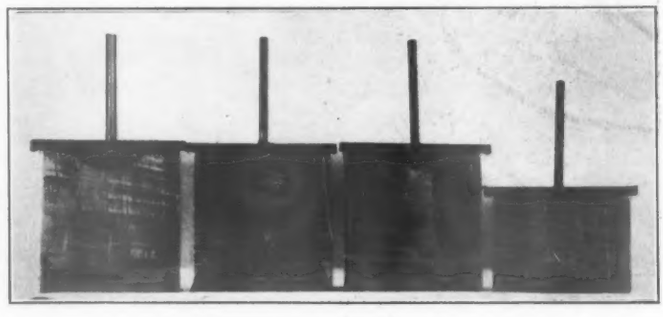


Fig. 7.—Castings poured through Gates varying from $\frac{3}{16}$ in. to $\frac{3}{8}$ in. dia., at Casting Temperatures from 1,060 to 1,080 deg. C.

size of gate is very fine, and, as a matter of interest, in preparing the specimen [exhibited] three attempts were made before obtaining a sound casting by this means. Sound castings by the second method can be obtained without difficulty.

Where it is impossible, by reason of design of casting, to have adequate gates according to the first method, the second method of medium-

the casting temperature has been excessively high that a waster will result. It can be argued successfully that this is not a shrinkage phenomenon, but is due rather to the gas condition of the metal. As it is affected by the gating, however, it has been included under the heading of shrinkage defect. In the case of the first casting, the gas causing this has been occluded before pouring.

sound castings by the use of a very low casting temperature with an extremely small gate.

Fig. 7 illustrates some castings made by methods similar to those developed by Ronceray for cast iron. The diameters of the gates range from $\frac{3}{16}$ to $\frac{3}{8}$ in., and the castings temperatures from 1,060 to 1,080 deg. C. Not one is perfect, and it can be concluded that the long freezing range, 160 to 200 deg. C., makes this method un-

suitable without some help in feeding from the gate. The most successful result was obtained by artificially reducing the freezing range by placing a chill on the bottom of the casting.

Gunmetal Risers

With gunmetal, as with other alloys, risers are used for two purposes, to clean and to feed the casting. For the first purpose the risers should be of such a section that they can easily be fed by the casting; the second type, in contrast,

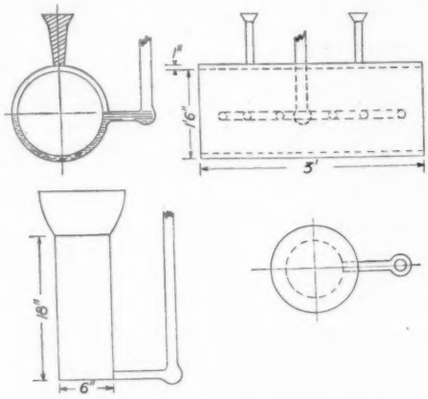


Fig. 8.—Two Types of Risers Used in Gunmetal Foundry Practice.

should be large enough to ensure that they will remain liquid after the casting has set. Between these two extremes risers used will show shrinkage defects where they join the casting.

The sketches shown in Fig. 8 illustrate the two types. The top diagram is interesting, as it illustrates how a small riser sets before the casting. With this particular casting, after the mould had been filled, it ran out almost to the parting, and when opened it was discovered that there was a gap between the risers and the casting, showing that the risers had been completely set when the

Fig. 9.—Homeyard Valve Casting, illustrating the Successful Use of Chills.

casting was still liquid. It is plain that this type is useless for feeding purposes. The lower sketch shows a type of riser or rather sinking head which, when used as shown, gave a perfect casting. When a riser has to be used for feeding purposes, it should be of the character of this second type. It has been found that casting temperature affects risers in a similar manner to gates, but it is not proposed to go into that here.

Use of Chills

Chills are extremely useful for decreasing the freezing time of a heavy section which may be cut off from feeding metal by the design of the casting. Their use in this respect can be equivalent to increasing the size of a gate or riser. Especially when cast-iron chills are used, however, difficulty is often experienced due to the gunmetal "blowing off" the chill, but this can be successfully overcome by the use of a suitable chill wash.

Fig. 9 shows a Homeyard valve casting which represents an example of the successful use of chills. This type of casting, cast in 12 per cent. tin gunmetal and ranging in weight from a few pounds to about 5 cwt., is probably one of the most difficult that the gunmetal founder is called upon to produce. The difficulties will be realised when it is stated that usually these valves are tested to 3,000 lbs. per sq. in. and occasionally to over 5,000 lbs. without any alteration in design; furthermore, in the smaller sizes a section only ¾ in. thick, right in the centre of the valve between two ports, is required to stand this pressure. The design of the valve gives a heavy body of metal cut off from the gates by thin sections. Before chills were used for this job a controlled casting temperature of 1,180 to 1,190 deg. C. was required. Since the use of chills the casting range has been increased to between 1,150 and 1,200 deg. C. with easier control and fewer defectives.

Two cast-iron chills are used on the outside, as shown, with a gunmetal internal chill on the top, the print of which can be seen. In effect these chills surround the heavy body of metal, reducing its freezing time to a rate commensurate with the rest of the casting.

Gating of Brass

In gunmetals, composition only affects the gating methods in degree, but in the brasses it is the main factor in deciding the method of gating a casting. From brazing metal with a zinc content of under 16 per cent. to a yellow brass of zinc content 25 per cent., the gates used are similar to those for gunmetal. Unlike gunmetals, however, there is another main consideration other than keeping up the shrinkage.

At the casting temperature of the yellow brasses a considerable amount of zinc vapour is constantly given off, and it will be realised that some of this zinc in the form of zinc oxide must remain in the casting, causing a greater or lesser degree of unsightliness according to the amount present. To keep the inclusions of this zinc oxide to a minimum the casting must be poured very quicky and to facilitate this the gates must be large.

With yellow brass the casting temperature has a similar effect on shrinkage as with gunmetal, but this is not so well defined and with small castings is obscured almost completely by the necessity for fast pouring. The cleanliness of a casting depends to a great extent, of course, on the vents provided, but if the gate is not originally suitable proper venting alone will not secure a clean casting. With the yellow brasses in particular the question of risers does not enter to any great extent, but when it does, the same considerations as for gunmetal apply.

Rotary Meter Bodies

The bottom series of castings shown in Fig. 10 give an example of yellow brass castings. They are rotary meter bodies and it will be seen that each is gated on a heavy part. The large size of the down-gate is noticeable. When the zinc in yellow brass rises much above 25 per cent., trouble is usually experienced in small castings. This appears to be due to increased solidification shrinkage. As a specific example, the castings illustrated are made in an alloy of 22 to 25 per cent. zinc, 4 per cent. lead, with the balance copper, and very little trouble is experienced. When, as an experiment, the zinc content in a batch of these was raised to 30 per cent., over 20 per cent. defectives were obtained. These castings were made from a standard pattern plate and gates. It was discovered that each defective was due to a drawn hole just at the position where the gate had joined the casting. It has not been

Fig. 10.—(Top) Small Nickel-Brass Castings. (Bottom) Rotary Meter Bodies in Yellow Brass.

proved, but it would appear that larger gates would overcome this trouble.

As the zinc content is increased, the solidification shrinkage becomes greater, and when the alloy, by additions of other elements, enters the range of high-tensile brasses, the ordinary non-ferrous gating methods previously described be-

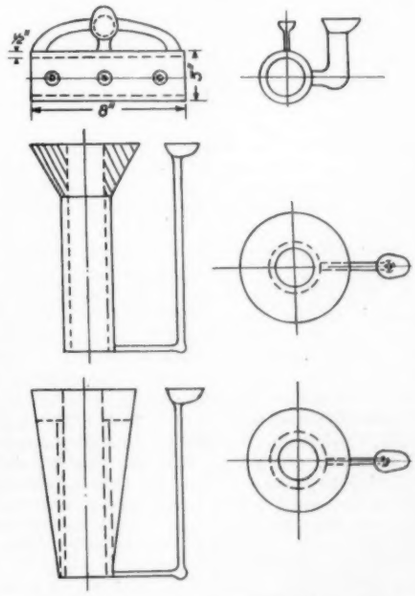


Fig. 11.—Bush Casting in 30 per cent. Hard Nickel Alloy.

come useless, and methods making extensive use of chills and extremely heavy risers have to be adopted.

Gating of Nickel Alloys

As with the brasses, the gating methods of nickel alloys are wholly dependent on the composition of the alloy used. The low-nickel con-

tent nickel-brasses are subject to the same methods as yellow brass, with similar considerations of shrinkage and zinc fume. Fig. 10 (upper portion) shows a spray of small nickel-brass castings in an alloy of approximately 10 per cent. nickel, 20 per cent. zinc and small additions of tin and lead, with the balance copper. The gates are similar to those which would be used for yellow brass. As the nickel content increases, usually at the expense of the zinc, the solidification shrinkage also increases until, with alloys containing about 30 per cent. of nickel, it becomes very difficult to overcome shrinkage trouble.

A troublesome interdendritic shrinkage appears which gives the part affected a red colour. At first sight this would appear to be a metal trouble, but that is not the case, however, as it can be cured by gating methods. It appears that in an alloy of this nickel content, progressive solidification from one part of the casting to another is limited and feeding metal must be supplied over the whole casting by a number of gates.

The sketches shown in Fig. 11 are of a bush casting in a 30 per cent. hard nickel alloy. Some time ago an order for a large number of these was completed. Before beginning the order several experimental castings were made in order to ascertain the best method. The top sketch shows the only method giving a perfectly sound casting, and represents that which was adopted.

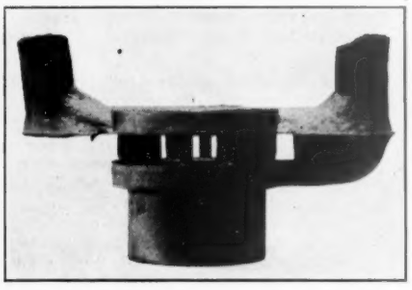


Fig. 12.—Lantern Bush in 20 per cent. Ni Alloy.

The method shown in the middle sketch was useless, the casting being drawn completely down the centre all round. The bottom sketch shows a means which probably would have given better results, but was not tried, due to the fact that the machining costs would have been prohibitive.

An attempt was also made to cast the bush flat, as on the top sketch, but only using two runners; in each case, however, the casting was drawn at the farthest point from the runners. The use of a chill core was of no avail. The method adopted, using three runners, gave satisfactory results and sample castings fractured as the job proceeded showed no signs of draws.

Fig. 12 shows a lantern bush in a 20 per cent. nickel alloy. Such an alloy has also a fairly high shrinkage, and to overcome this the casting has been treated as if it were really two castings, the top ring forming one and the bottom part the other. Each part has its own runner, and the size of the down-gate and runners are noticeably large. A very satisfactory job was obtained by this method. With the alloys of higher nickel content, such as Monel Metal with over 60 per cent. nickel, special methods, involving heavy feeding heads, are required.

In conclusion, the author wishes to express his indebtedness to Mr. H. Gardner, works manager of Glenfield & Kennedy, Limited, Kilmarnock, for permission to publish the information given in this Paper, and to Mr. F. Hudson, chief metallurgist, for his invaluable advice and for preparing the lantern slides.

A Novel Cupola Firebrick

A cupola brick possessing a novel construction has been developed by Mr. L. T. Makram, of 4, Duke Street, Adelphi, London, W.C.2. Its general form is shown in Fig. 1, and by correlating the accepted tenets of the science of refractory materials with practical design, it will be seen that (1) to prevent the lowering of the melting temperature through pressure, the pressure of one brick upon another is taken up in a position where the bricks should be relatively cold; (2) the cooling of the points of contact between brick and brick is assured by the inclusion in the design of air spaces. It might well be asked if theory works out in practice, and in this connection there is a report available from a South of England foundry which states that a 27-in. cupola was lined at the end of 1936, for the purpose of melting for long periods high steel-mix charges. It was fortunate that coincidently with the starting up of this cupola, a second one was also placed in commission and lined in the usual manner with firebricks, but these burnt back quickly in the fusion zone, whilst in general the joints have opened up. The Makram bricks, after twelve

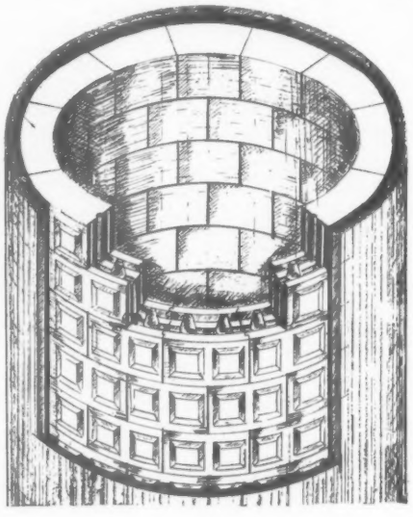


Fig. 1.—The "Makram" Cupola Firebrick.

months' service, show the joints still to be in good condition. We have made no personal investigation of the cupolas referred to, but on theoretical grounds, we appreciate the design. Obviously, if the bricks be carefully dimensioned for each diameter of furnace, enhanced speed in erection should be ensured. The system might with advantage be tried out in rotary furnaces, yet because of the horizontal setting, some of the advantages would obviously be lost. In the case of cupola linings, we think that the bottom of the cupola should be designed so as to take full advantage of the "chimney effect" inherent in the design. The system is covered by patents numbered 16793 and 27159 of 1936 and 815667, 818025 and 818028 of 1937.

(*Concluded from next column.*)

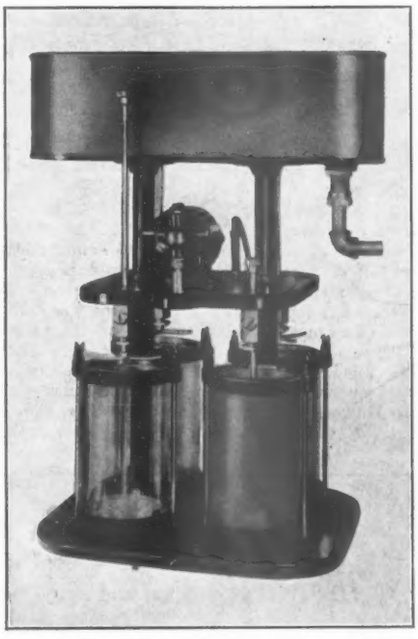
"A.F.A." clay-substance contained in moulding sands. The percentage clay content is a valuable test figure in the purchasing, distributing and plant control of moulding sands. The clay washer, by making this test simpler, will do much towards increasing the use of this sand test figure. It is manufactured by the Harry W. Dietert Company, of 9330, Roselawn Avenue, Detroit, Michigan, U.S.A.

A New Clay Washer

The clay washer illustrated below automatically washes the clay substance from moulding sands. The tedious intermittent hand syphoning is eliminated, saving considerable labour, and eliminating the human equation. The time required to wash the sample is also reduced, and four samples may be washed at one time. Wash bottles with removable bottoms are supplied so that the clay-free sand grains may be removed from the wash bottles without filtering, and dried in an oven.

The clay washer consists essentially of the following: a base receiving the four wash bottles; two supporting posts with a table on which is mounted the motor and drive mechanism to rotate the four washing tubes immersed in the sand sample; and a water tank containing a float valve to maintain a constant level of water in the tank.

The principle of operation is very simple. Water from the tank travels through the posts



The New Clay Washing Apparatus.

to the stirring tubes, which are rotated and immersed in the sand sample. The water leaves these tubes in a four-pronged crow foot located at the bottom of the tubes. This causes water to wash the clay out of the moulding sand. The rate of water flow is such as to cause water to flow upward in the wash bottles at the rate of 1 in. per min. Sand particles larger than twenty microns will fall faster than 1 in. per min., so that the water will carry out of the water bottle only particles twenty microns and smaller. The standard A.F.A. syphoning principle is reversed in the clay washer, thus yielding testing results within practical tolerances. The water carrying the clay substance flows over the top of the wash bottles and drains out of the base of the clay washer.

A thermostatic water heater is mounted in the water tank to maintain a water temperature of 75 deg. Fah. Distilled water is recommended for research tests, while tap water may be used in certain localities for control tests. The float valve will operate against water pressure up to 75 lbs. per sq. in.

The clay washer is a practical and valuable apparatus for both sand producers and foundries to enable them to obtain the percentage of

(*Concluded in previous column.*)

Time Control in the Manufacture of Repetitive Castings*

By BERNARD BROWN, B.Sc.

[*Slightly Abridged.*]

Definition of Time Control

The phrase "time control" means simply labour control or management methods for ensuring a fair day's work for a fair day's pay. This statement may sound controversial, but there appears to be no other true way of stating the facts. Whatever opinions may be possessed on the subject, there must be agreement that some form of labour control is essential to any factory or foundry. There are three main methods of doing this.

Day-work payment is usually made at such a level as to maintain good relations between the men and the directorate of the company, and the foreman has his own particular methods of maintaining discipline. This system is satisfactory if exactly the right type of foreman is available, but this is not easy, especially when many foremen have to be engaged to cover the activities of hundreds, and sometimes thousands, of operatives. For the men the system is not so satisfactory, since, however hard they work, they are paid the same, and furthermore, they are subjected to the whimsicalities of their foreman.

The second method of control is that commonly known as incentive payment or payment by results. This enables the man to earn more money if he produces faster, though not always in equal proportion. Piecework, premium bonus of its various types, the Rowan system, tonnage bonuses, etc., all come within this category. It may be wondered why a system of incentive payment can be regarded as a method of time control, and it may be argued that it is introduced to allow the man to make more money if he cares to work harder. This is definitely not the modern conception of incentive payment. Piecework, or bonus, when set, must be earned, and the amount earned or lost forms the means of time control.

The third system is that where men are paid high day-work rates and must maintain a definite level of output, any fall of production meaning a reprimand.

Importance of Time Control

The importance of time control in any foundry depends naturally upon the ratio of labour cost to production cost. It might be contended that in certain classes of work, where the average weight per casting is a ton or more and the class of moulding relatively simple, time control matters very little, since it is completely overshadowed by the cost of pig-iron and scrap. To a certain extent this is true, but for the purpose of the present Paper consideration is only given to foundries producing a light type of casting (averaging, say, ten pounds each) in large quantities, but of such varying types as to render what might be termed continuous production nearly impossible. In this case the labour/material ratio might be of the order of one to one, that is to say, labour is equally important as material. Nevertheless, it must be borne in mind that, no matter how small labour may appear as compared with material, it is important, since, more often than not, it is the one factor under the direct control of the management. Raw material prices are controlled by market conditions, and, although an astute buyer may economise by a fraction of a per cent., this becomes increasingly difficult.

Industrial Position of Time Control

Time control was first used in the old-time piecework gangs where a master moulder was paid so much per job and engaged his own labour, naturally retaining as much of the proceeds as possible for himself. Besides this, there were innumerable bonus schemes based on tonnage. In explanation of Taylor's system, it may be stated that Taylor refused to guess or evaluate by experience the time which ultimately controls profits, which should be allowed for a particular job, and instead, devised means for measuring it. Taylor's experiments have been

Fig. 1.—Simple Mould Produced on a Pneumatic Moulding Machine.

the basis of formidable ramifications of time and motion study from which have been evolved conveyors and recorders, micro-motion study and slow motion cine-camera work. Most activity along these lines has been displayed in America, where quantities are high, as also are labour rates. In Great Britain, time study was first adopted by the newer industries, such as automobile and the light electrical engineering companies, though now it is commonly encountered in almost every branch of industry. In the opinion of the writer, it may be regarded as perhaps the greatest advance in industrial organisation.

Fig. 2.—Mould Produced on a Moulding Machine using Snap Flasks and Vibrating Pattern Plates.

Rational Rate Setting

The most elaborate methods of determining a time are made with the single object of fixing a particular rate of working for an operative. The old-time foreman set his rates or prices by his experience of what he thought was accomplished. For example, he knew that one operator always produced sixty-three 16 in. by 12 in. boxes a day, and he therefore set his piecework price per box.

A modern time-study man with his stop-watch, performance and fatigue curves arrives at a rate of working which should be achieved by a man of average intelligence and average application to his job. By various devices he endeavours to eliminate from his calculations the human factors of the particular individual, working only for the average. He endeavours to measure the energy required for the performance of a particular operation and to translate this into a time or piecework price. Neither of these methods is correct. The old-time foreman only knew what had been achieved, not what should have been done, and he automatically made his price so that it compensated for waiting for metal and the like during a normal day. On the other hand, the too scientific time-study man frequently makes so many corrections for the innumerable factors appertaining to the performance of work that he often dares not submit his findings without obtaining some confirmation from the foreman.

Good rate fixing, which is not too often encountered, is a combination of scientific observation and common sense. The actual time of a job is, obviously, the time which that job takes, yet there are men who argue for hours on how long a particular operation would take, avoiding for their own obvious reasons an actual trial against time.

Quite a common statement is that all types of work cannot be timed, but the author has not encountered any jobs upon which a time cannot be set, though not always with advantage under the particular existing circumstances. If a time cannot be set reasonably easily on the majority of repetition jobs, it may be taken as fairly indicative that there is something radically wrong with the methods employed. For example, if a drilling operation is being timed and the operator spends twenty minutes at the stores in obtaining a $\frac{5}{8}$th reamer, it is fairly apparent that something is amiss with the system and must be corrected before one makes any further effort at settling rational rates.

The author contends that foundry work can be rate-fixed by normal engineering methods employing the stop-watch. From the viewpoint of the rate fixer or time-study man, the foundry presents certain difficulties, as, for example, the wide divergence of operative dexterity between different moulders, but these are not insuperable barriers to reasonable accuracy. The foundry does have some advantage in that the basic materials used are simple and not likely to cause trouble. Thus, give a moulder a pattern plate, boxes and sand, and he will produce moulds, but in other engineering shops many things may go wrong.

Time Control Further Explained

It must be pointed out that time control is almost invariably associated with incentive payment. When reference is made to piecework or bonus actually a labour time is meant. Time control is: (1) the setting of a time by rate fixing, and (2) the recording of the time the operator or moulder has taken whilst on the job and a check of the amount of work, *i.e.*, the number of castings produced.

In many factories it is found that one element of time control is in operation without the other. Sometimes there is an elaborate rate-fixing department which sets times very accurately, whilst the organisation takes no particular care that these times are met or that there is an exact count of the parts produced. In just the same manner there will be found factories with clocking-in systems and rigid rules against latecomers and similar delinquents and complete omission to check that men are working whilst in the building. It is sometimes said that the cost of running an elaborate piecework system may more than offset the economies thereby

* A Paper read before the East Anglian Section of the Institute of British Foundrymen, Mr. L. Tibbenham presiding.

introduced, but this need not be regarded seriously.

The type of incentive with which this Paper is principally concerned is that known as the "standard time" or "time piecework system," which, in the experience of the author, is the simplest, most direct, easiest-applied and of widest application. The standard-time system is similar to the premium bonus scheme in so far that a time is set for every job and the operator gains by the amount he is quicker than the set time. However, the operator gains the total amount instead of a fraction as in the case of the premium system. This is simply time-piecework, a particular time at a particular rate per hour being allowed for a particular job. Obviously 15 minutes at 1s. an hour = 3d., which is equivalent to a price piecework.

It may not immediately be apparent why a time is preferred to a price when they amount to the same thing. A little consideration will show that times possess numerous advantages. For example, those familiar with piecework systems know the trouble ensuing when a job with a piecework price designed for a boy has temporarily to be done by a senior grade of labour. In foundry work this is particularly noticeable. Sometimes graded piecework prices are set to be applicable according to the age or experience of the labour, but really each particular job should have its assigned grade of labour. In the standard-time system, however, a job may be transferred from one operator to another with perfect fairness, since the time allowed per job is taken at the rate of the operator. This does not mean that a foreman may change the grade of labour on the job just as he pleases, for, on the contrary, the grade of labour to be used on the job is specified, a convenient one being "junior," "medium" and "senior," though some firms grade much more finely, depending upon the size of the concern and the number of men available. It is naturally not worth while grading closely when one employs only a few dozen hands.

A further advantage accruing to the use of times is that one is enabled to pay for a rate of work rather than for the completion of a particular job. Studying the question logically, it is evident that the employer, in introducing an incentive system, is endeavouring to "speed up" production, or, in other words, make his employees work faster, and, as an inducement, he is willing to pay them more money for increased effort. It is obvious that he is not expecting them to speed up one job, slow down on the next and so on; nor is he expecting them to speed up on piecework jobs and immediately slow down when a certain amount of day-work has to be booked. It is absurd to pay piecework on the job, and instead it should be paid upon a summation of the jobs taken over a period such as a week. At the beginning of the next week an operator starts afresh, and is not perpetually in debt. The standard-time system makes it possible for this summation of jobs to be carried out extremely quickly and simply in the pay-roll department, as will be explained later. The standard-time system also simplifies the planning of work. If the piecework price of a job is, say, 2d., it is difficult to convert this cash amount into number of boxes per hour. Finally, the direct use of time as a measurement of work is so obvious and logical as to appeal to anyone if only by virtue of its extreme directness and simplicity.

How a Standard Time is Set

There is a vast difference between a correctly set standard time and a simple floor to floor stop-watch reading. In the first place, the untrained observer is incapable of determining how long even the simplest job should take, though he uses the most accurate stop-watch. It would be out of place in this Paper to describe the various methods adopted in determining the correct floor to floor time of an operation. Nevertheless, it may be said that a short series of stop-watch observations, modified by the experience of the rate-fixer, form its basis. An experienced rate-fixer can usually determine in ordinary foundry work a sufficiently accurate time by a series of not exceeding three observations, providing, of course, he has previously logged certain fundamental times applicable to the particular foundry. It is particularly to be emphasised that the time observed, say, for the moulding of a box is not necessarily the one used in the setting of a standard time, since the moulder may be slow or superlatively fast.

Table I.—*Standard Time for a Simple Moulding Machine Job.*

	Min.	Secs.
Net rate fixed time	1	7
Bonus (25 per cent.)	0	17
Contingency (48 min.-hour = 1/5)	0	13
	1	37

Table II.—*Time Study for Moulding Mangle Top Sides.*

Method :—Snap flask with pneumatic lift. 1 operator —medium.

	Secs.
Place bottom of box on table	2
Assemble pattern plate	2
Clean off (air)	3
Assemble top of box on pattern plate	5
Dust with parting powder	5
Sieve facing sand	20
Assemble band	4
Shovel sand	13.5
Ram down	10
Smooth off	3
Assemble bottom board	5.5
Turn over	2.5
Dust with parting powder	4.5
Assemble band	6
Sieve facing sand	14
Shovel sand	10
Smooth off	3
Assemble pressure board	5
Press in machine	8
Tap plate and remove	3
Make runner hole	3.5
Lift top (vibrator)	18
Tap and remove plate	14
Close up (and remove flask)	12
Place down	8
	184.5

In normal machine shop practice, there are certain standards for the usual manual operations which have been determined by many hundreds of observations as applicable to the average operator. Thus, for example:—(1) Reading a micrometer, 7 secs.; (2) feed to stop in small capstan lathes, 4 secs.; (3) raise table of milling machine from 4 to 0 inches, 7 secs.; (4) index head of capstan, 3 secs.

In the foundry, although it may not immediately be evident, a similar set of constants may be obtained. For example, some of them are:—(1) Place a 16 in. by 10 in. box on two dowels on machine, 11 secs.; (2) dust average pattern with parting powder, 4 secs.; (3) weight down boxes, 5 secs.; (4) make runner or vent hole 1 in. diameter, 11 secs.; (5) place and position core up to 3 in. by 3 in. in mould, 16 secs.

The actual time allowed for a job is a combination of average observed times like the above, modified by the observations taken by the rate-fixer, and, as it were, bound together by his experience. Having in this manner determined the actual or net floor to floor time of the job, the standard time is prepared as below.

Two further percentages are added, the first being what may be called the bonus time which is determined by the percentage bonus which the average man is supposed to earn when working normally. Usually, this varies from between 20 to 50 per cent., though 25 per cent. is quite a common and recognised figure. The second addition is the contingency allowance. This may be taken to cover fatigue, temporary stops and absences, and the normal trivial happenings which tend to cause lowering of a man's rate of work. If a particular job actually takes 1 minute to produce, probably between 40 and 55 will be produced in an hour, depending on the type of job. All this has been dealt with many times in great detail, and is applied most scientifically, notably in the Bedaux system. Thus, the standard time consists of the actual or floor to floor time plus a bonus time plus a contingency. Contingency allowance is usually expressed in the form of a so many minute-hour. Thus, for example, in the foundry the following figures have been found and proved by experience to be suitable:—

(1) Snap flask work on hand, squeeze machine, 48 minute-hour.
(2) Hand ramming with stripping plate and metal boxes, 45 minute-hour.
(3) Plate moulding on floor with boxes up to a size capable of being lifted by two men, 40 minute-hour.

These figures are respectively equal to one-fifth, one-quarter and one-third additions to the actual or net time.

Fig. 1 shows a simple type of mould made on a pneumatic Tabor type machine. It will be seen that it presents no peculiarities except that in practice the direct squeeze was found insufficient, and a certain amount of hand ramming had to be employed. The time allowed for the performance of this job is shown in Table I, which also indicates how this particular standard time was compiled.

Table III.—*Time Study of Moulding Mangle Top Sides.*

No. per box: 1. Machines: Two Tabor power squeeze 4-ft. Operators: Medium.

Operation.	1st study.		2nd study.		3rd study.	
	Bottom.	Top.	Bottom.	Top.	Bottom.	Top.
	Secs.	Secs.	Secs.	Secs.	Secs.	Secs.
Clean off (air)	4.0		4.0	2.5	3.4	3.0
Place box on table	7.0		7.0	5.0	8.0	5.0
Put down box lever	4.0		—	—	—	—
Dust with parting powder	3.0		3.0	—	3.0	—
Placing facing sand in box by hand	7.0		7.0	3.0	7.0	3.0
Shovel sand from floor	7.0		7.0	5.0	5.0	—
Hand ram	9.0		9.0	3.0	8.0	—
Release hopper	5.0		4.5	6.0	5.0	6.0
Squeeze	5.0		5.0	5.0	5.0	5.0
Ram down by hand	4.0		5.0	—	—	—
Tap to release	4.0		4.0	3.5	4.0	4.0
Smooth off	3.5		3.5	3.0	3.5	3.0
Lift	4.5		4.5	5.0	4.0	5.0
Place down	4.0		3.5	4.0	5.0	4.0
	71.0		67.0	47.0	51.0	38.0

(*Continued on page* 300.)

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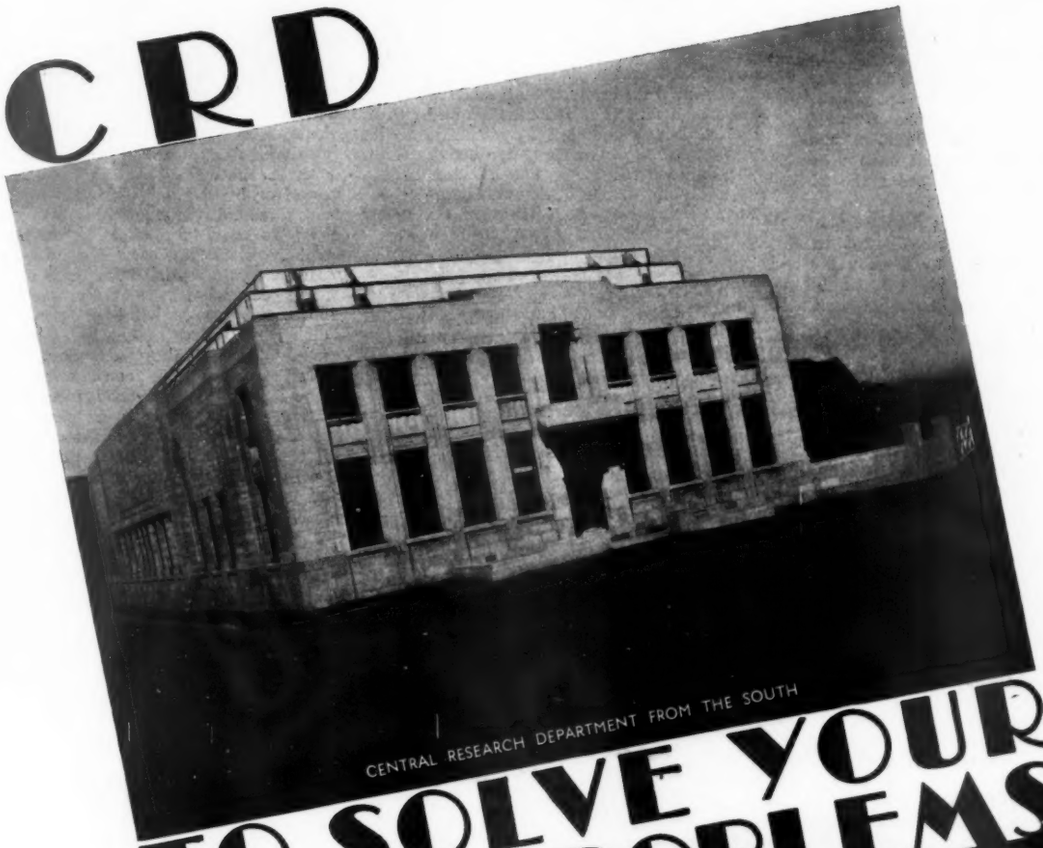

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Application in the Foundry

Fig. 2 shows a similar type of mould produced on the familiar Farwell type of machine utilising snap flasks, and vibrated pattern plates. The time study relating to this particular job is shown in Table II. It will be seen that the floor to floor time is 185 secs., which, when the contingency and 25 per cent. bonus are added, equals 4 min. 30 secs. For convenience of transmitting the information to the moulder, the time is frequently converted into an output of so many per hour, in this case 16½ to make 25 per cent. bonus.

This example shows, perhaps, the simplest case of utilising time study and standard-times in the foundry, as when applied to a moulder completing both parts of a mould in a single operation and carrying his completed job and placing it ready for pouring.

A more complex case occurs where a pair of moulders are employed working on the respective halves of a job, and Table III shows first the rough conditions persisting when the original time study was taken, where it was found that one moulder was taking 71 secs. and the other 47 secs. The time of production of one completed mould was obviously that of the longer job, *i.e.*, 118 secs.* A simple revision of the operations of the two men combined and resorted is shown in the second study in the lower part of Table III, where it will be seen that these are now more closely balanced. The third study shows a further reduction due to the elimination of unnecessary operations, but still exhibits the loss due to unbalance, which is an almost inherent feature of two-operator machine moulding.

It may be objected that this is a somewhat obvious case and that skilled men make this correction themselves. To a certain extent this is true and the author has observed cases where men knowing nothing of stop-watches or rate-fixing have yet balanced their times very accurately. However, it must be pointed out that with machine moulding and the grade of labour encountered, such refinements are not easily appreciated. Indeed, it is often difficult to make one of a pair understand why he should do a certain amount of work which apparently belongs to his neighbour.

So far only those cases in a foundry have been considered which may be regarded as direct labour, *i.e.*, moulding. However, when one considers the total foundry costs it is quickly apparent that moulding may represent only a half of the normal labour charges of the department. A very important group is the pourers, and their work may be reduced to a standard time basis in a similar manner to that previously described. Owing to the fact that the pourers work as a gang or series of small gangs and not as individuals, the standard-time set would apply to a group which is equivalent to group piecework. Setting rigid times on moulders implies that they must be supplied continuously with metal, sand and a service for the removal of the castings. It is absurd to operate a foundry with moulders on incentive payment and pourers on day-work, since, assuming a limited supply of boxes or floor space, the moulder is entirely dependent upon pouring and floor clearance for the continuance of his activities. Within the space available it is not possible to present all the details of the time studies which go to the determination of the actual time necessary for pouring a box. It may, however, be remarked that all factors considered, it was found possible to set standard times per box of a particular dimension. Some standard times used are:—

(1) Average snap flask box on Farwell machine, 1 min.

(2) Average 16 in. by 10 in. metal boxes on mechanised loop, 1 min. 40 sec.

(3) Average large mangle bottom side boxes, 2 min. 30 sec.

* We have reproduced the author's figures without emendation. This also applies to Table III, cols. 4 and 5.—Editor.

When the investigation of standard times for pourers was made the question of a bonus on tonnage was considered. The facts, however, demonstrated irrefutably that this would not be satisfactory. The times set above are allowed per box, and they embrace metal carriers, ladle attendant and crane driver. For example, if one hundred 13 in. by 9 in. snap flask boxes were poured, this meant that the time allowed was 100 by 1 min., which equals 1 hr. 40 min. divided between, say, one crane man, five metal carriers and one ladle attendant. The division of payment at the end of the week takes place according to the number of hours worked by each man and also according to the rate per man.

It is to be emphasised that although this is a group system of payment it is not in any sense of the word a bonus scheme; it is direct-time piecework, and must be maintained by the foreman manipulating either the number of men working or the hours they work, according to the fluctuation of boxes produced.

(To be concluded.)

The Crystal Palace

Recently it was announced that Messrs. Thos. W. Ward, Limited, Sheffield, had obtained the contract for the clearance of the Crystal Palace site and the sale of the material. As a matter of interest it may be recorded that the Palace

View Taken after the Fire.

was destroyed by fire on the night of November 30, 1936. It was originally built in Hyde Park, and was brought into being by the Great Industrial Exhibition which was held there in 1851. It was designed by Sir Joseph Paxton, and the Prince Consort played a leading part in its inception. After the Exhibition the Government of the day would not undertake the responsibility of its purchase or retention in Hyde Park. Eventually it was transferred to Sydenham, and was opened to the public in June 1854, after something like £1,350,000 had been expended on the building and site.

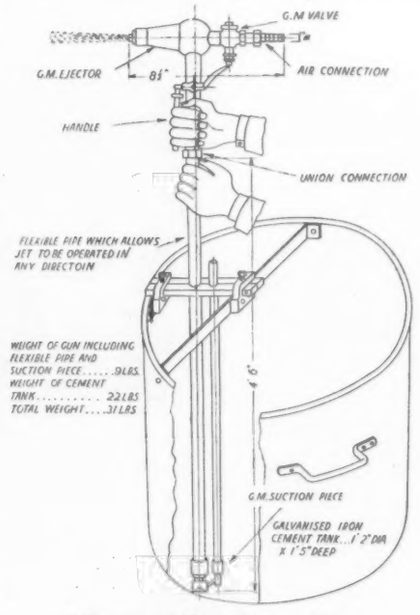
The buildings and site of 200 acres became the property of the nation in August, 1914, a day or so before the outbreak of the Great War. The glass-covered portion covered 24 acres. The framework was made of cast iron, with roof girders and cross-ties of wrought iron, and it is estimated that something like 15,000 tons of cast iron and 1,000 tons of wrought iron will be recovered.

"Pyruma" Fire Cement Gun

The unique bonding, hard setting and heat-resisting properties of "Pyruma" are already very well known and the cement has found a wide field of usefulness in the gas works, power works, iron and steel works, coke works and for industrial heat users generally. Hitherto, however, its method of application has been by the trowel or brush; but with this form of application a certain amount of waste was unavoidable; further, the effective filling up of all cracks, interstices and, more particularly, corners, was attended with some difficulty.

The possibilities of "Pyruma" have been appreciably extended by the fire cement gun which has recently been introduced by J. H. Sankey & Son, Limited, of Ilford, Essex. The construction of the gun will be readily understood from our line illustration, which shows it in part section. The gun itself is in gunmetal, the cones inside being of steel, and the other component parts brass. The tank is stout galvanised sheet and the hose is specially reinforced, but the total weight of the complete apparatus is only 31 lbs. The gun is designed for a working air pressure of 40 to 50 lbs. per sq. in.

Fired at an average distance of 3 to 4 ft. from the brickwork to be coated, the surface is



"Pyruma" Fire Cement Gun.

covered in but a fraction of the time occupied by brushing or trowelling. Not only are time and labour saved, but the coating is more permanent. The full impingement of the cement from the gun penetrates the pores of the firebrick and firmly fills up all cracks, crevices and corners. It sets rock hard and thoroughly welds itself to the original firebrick lining. It may be noted that the firebrick work must not be damped prior to using the gun.

When necessary, as in the case of old and well-worn firebrick, considerable thicknesses of "Pyruma" can be built up, say from ¼ in. to ½ in. For operation the main gun piece is coupled to the flexible pipe through which the cement is fed, the small pipe attached to the main pipe is for the ordinary air inlet, and the air hose is coupled to the tail pipe of the gun. The gun is put into operation by pressure upon the conveniently-placed handle, whilst it will be seen that the jet can be operated in any desired direction.

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LONDON OFFICE - - 16, GROSVENOR PLACE, S.W.1.

The Week's News in Brief

Trade Talk

Harland & Wolff, Limited, the Belfast shipbuilders, are to construct an aircraft carrier for the Admiralty.

The Shotts Iron Company, Limited, is to erect a brickworks at Roslin. The contracts for the work have been placed.

Davy Bros., Limited, of Sheffield, have transferred their London office to Steel House, the recently-completed headquarters of the British Iron and Steel Federation in Tothill Street, S.W.1.

A. C. Wickman, Limited, Coventry, have been appointed agents in the United Kingdom and the Irish Free State for lathes and cutter grinders made by R. K. Le Blond Machine Tool Company, Cincinnati, Ohio.

The directors of General Refractories, Limited, have decided that the price of the issue of 300,000 new 10s shares in the company shall be 25s. per share. The offer is being made to existing shareholders in the ratio of three new shares to every ten old shares held.

A considerable extension to the textile division of J. H. Fenner & Company, Limited, Hull, is being made. A special feature of the new building is the heat and air control system, which will enable perfect working conditions to be maintained at all times of the year.

A plan arranged by the Central Executive Committee and the Council of People's Commissars of the U.S.S.R. provides for an output of more than 16 million tons of pig-iron, more than 20 million tons of steel, 145,000 tons of copper, 41,000 metal cutting lathes, 1,900 locomotives and 220,000 motor-cars for 1937.

In a report issued by the General Iron Fitters' Association, whose head office is at Falkirk, the secretary, Mr James Fraser, states that in the industries covered by the Union, trade steadily improved throughout last year, until by the end of December the Association had no able-bodied unemployed members.

Steel used in the manufacture of motor-cars, when of the class or kind not produced in Canada, is now allowed to enter Canada from Great Britain free of duty. Makers of lorries and buses need show only 40 instead of 50 per cent. of the finished product to be of Empire content in order to secure the lowest duties on imported goods.

At the annual meeting of the Foremen's Mutual Benefit Society in the Ayrshire (South) District, held in Kilmarnock recently, Mr. W. D. Bell (Andrew Barclay & Company, Limited) and Mr. Thos. Miller (Ailsa Shipbuilding Company, Limited) were re-elected members of the district committee on behalf of the contributory members, and Mr. A. Watt, Mr. T. Grieve and Mr. D. Murray were elected on behalf of the ordinary and associate members, to hold office for two years. Mr. Robert Cunningham (Glenfield & Kennedy, Limited) was re-elected district secretary.

We are informed that it has been decided to proceed with the sinking and equipment of a new colliery at Workington, to work the undersea coalfield lying to the west of the area occupied by the United Steel Companies' works. There are approximately 6 square miles of undersea coal royalty, measured to the 3-mile limit from high-water mark, which it is intended to develop under this scheme, and the estimated reserves are very large. The first 150 ft. of each 21 ft. dia. shaft will be sunk through sand and gravel (which contains water) by the freezing method of sinking, and will be permanently lined with cast-iron segments and concrete. The remaining 450 ft. of each shaft will be sunk through the ordinary coal-measure rocks by the ordinary method of sinking and will be permanently lined with brickwork.

New Company

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

John Harper (Meehanite), Limited, Albion Works, Walsall Road, Willenhall, Staffs.—Capital, £30,000. Manufacturers of castings in Meehanite metal, iron, brass, etc.

Company Reports

Heenan & Froude, Limited.—Interim dividend of 4 per cent. on the ordinary shares.

Skefko Ball Bearing Company, Limited. — Final dividend of 20 per cent., making 30 per cent., free of tax, in respect of 1936.

Robey & Company, Limited. — Profit for 1936, £11,872; carried forward, after providing for depreciation, interest, fees and other charges, £2,022.

Smith & McLean, Limited.—Profit for 1936, after depreciation and income tax, £40,768; brought in, £21,354; to reserve, £15,000; preference dividend, £4,728; dividend on the ordinary shares of 9 per cent., £13,725; carried forward, £28,671.

Parker, Winder & Achurch, Limited.—Profit for 1936, after depreciation and income tax, £14,916; brought in, £4,672; preference dividend, £1,006; dividend on the ordinary shares of 7 per cent., £4,323; to reserve, £5,000; carried forward, £9,258.

Worthington-Simpson, Limited.—Profit for 1936, after depreciation and debenture interest and provision for contingencies (including tax), £27,377; undistributed profits brought in (after capitalising £20,000 issued as bonus shares to ordinary shareholders), £4,002; proportion of preference dividend equalisation reserve not now required, £9,448; preference dividend, £4,445; ordinary dividend of 7 per cent., £17,080; general reserve, £5,000; carried forward, £14,302. Meeting, April 9.

Imperial Chemical Industries, Limited. — Gross income for 1936, £9,049,422; net income, after providing £1,000,000 for central obsolescence and depreciation fund and £846,093 for income tax, £7,203,329; brought in, £638,740; preference dividend, £1,591,014; 2½ per cent. interim dividend on the ordinary stock, £1,229,973; to general reserve, £1,500,000; workers' pension fund, £150,000; final dividend on the ordinary stock of 5½ per cent., making 8 per cent. for the year; carried forward, £665,142. Meeting April 29.

Hadfields, Limited. — Trading profit for 1936, £269,489; debenture interest and profit and loss items, £50,066; net profit, £219,423; brought in, £102,697; preference dividend, £10,294; interim dividend on ordinary shares, £26,589; final dividend of 10 per cent. (making 13¾ per cent. for the year), £70,904; carried forward, £214,334. During the year the company disposed of its holdings in Beans Industries, Limited, thereby realising a net capital profit of £366,900. Out of this profit £86,411 has been set aside as provision towards works development, reorganisation and contingencies, £37,500 to the establishment of a staff pension scheme, and the balance of £242,989 has been transferred to capital reserve. The directors propose to make a capital distribution to the ordinary shareholders out of the capital reserve of £242,989 to the amount of one shilling in respect of each ordinary share.

The Properties of Synthetic and Semi-synthetic Foundry Sands

I. D. Derechinsky, writing in "Liteynoye Dyelo," gives an account of a method of preparing a semi-synthetic mixture of foundry sand and the replacement of this mixture by a synthetic mixture for a given group of castings. The chemical analyses, the physical and chemical properties and the granular composition of all the raw materials and foundry mixtures are given. The variation of the strength of foundry sand and its permeability to gases with the moisture content has been investigated, as well as the effect of the addition of a clay suspension to used foundry sand. The variation in the properties of the mixture with the method of adding the clay has also been studied, as well as the use of dry ground clay and emulsions. The results are stated to show that the introduction of clay in the form of emulsion gives mixtures which are rather superior in quality to mixtures in which ground clay was added. These conclusions have been confirmed by actual foundry practice, it being found that 6.3 kg. of any clay may be replaced by 1.3 kg. in suspension (referred to the dry clay content). The specific gravity of the suspension should not be greater than 1.08 to 1.10. Finely ground coal-dust forms a stable emulsion with a clay suspension, laboratory experiments showing that it is possible to obtain such an emulsion containing 50 per cent. of coal-dust.

Personal

Mr. A. T. Green has been appointed director of research to the British Refractories Association.

Mr. James Doran, who for 35 years was buyer for Bamfords, Limited, Uttoxeter, Staffs., received presentations from the staff and directors when he retired recently.

Mr. R. O. L. Chorlton, chairman of Ashworth & Parker, Limited, Riverside Works, Bury, Lancs, has been elected President of the Manchester Association of Engineers for 1937-38.

Mr. Charles Roberts, the Scottish representative of the Fordath Engineering Company, Limited, West Bromwich, has changed his address to 132, Fergus Drive, North Kelvinside, Glasgow, N.W. (Tel. No. : Maryhill 1198.)

At the annual meeting of British Insulated Cables, Limited, held in Liverpool last Friday, the shareholders presented for the custody of the Board, a portrait of Mr. George H. Nisbett, M.Eng., the managing director of the company, painted by Sir William Llewellyn, President of the Royal Academy.

Obituary

The death occurred on March 29 of Mr. Richard William Ross, late chief engineer of Smith & Wellstood, Limited.

Mr. Fred Haighton, a director of R. Haighton, Limited, ironfounders, Vulcan Ironworks, Nelson, Lancashire, has died suddenly at the age of 54.

Mr. H. A. Couves, general manager and director of the North-Eastern Electric Supply Company, Limited, Newcastle-upon-Tyne, died in London on March 25.

Mr. Arthur Sanderson Bleckly, for many years chief chemist at the works of Pearson & Knowles Coal & Iron Company, Limited (now the Lancashire Steel Corporation, Limited), died on March 29, aged 66 years.

Mr. George Batty.—Mr. E. M. Forrester, of 9, Osgathorpe Road, Pitsmoor, Sheffield, writes :—It is with deep regret I read in The Foundry Trade Journal of the death of Mr. Geo. Batty. Mr. Batty and myself were great friends at one time, especially when we worked together at John Brown & Company, Limited, Atlas Works, Sheffield, where we were both engaged in the steel foundry department; that was before the war. I lost touch with Mr. Batty about two years after the war, as I went out to India about the same time Mr. Batty went to America. I am sure all who knew him in Sheffield will deeply regret to hear of his death. He was a fine fellow and a great man at his work.

Contracts Open

Exmouth, April 19.—1,100 yds. of 6 in. diam. and 450 yds. of 4 in. diam. sand-spun cast-iron water mains, for the Urban District Council. Mr. S. Hutton, engineer, Council Offices, Exmouth.

Finningley, April 23.—2,500 yds. of 3-in. and 4-in. spun-iron pipes, for the East Retford Rural District Council. Mr. J. Turrill, surveyor, 2, Market Square, Retford, Nottinghamshire. (Fee £2s 2s., returnable.)

Gloucester, April 14.—Cast-iron pipes and/or special pipes, for the Cheltenham and Gloucester Joint Water Board. Mr. C. J. Scudamore, joint engineer, 21, Eastgate Street, Gloucester. (Fee £2 2s., returnable.)

Southport, April 12.—790 yds. of wrought-iron fencing with cast-iron standards, for the Town Council. The Borough Engineer, Town Hall.

Forthcoming Events

Institute of British Foundrymen

APRIL 10.

West Riding of Yorkshire Branch :—Open discussion on subjects raised by members, at the Technical College, Bradford, at 6.30 p.m.

APRIL 16.

Middlesbrough Branch :—Visit to the coke-oven plant of Dorman, Long & Company, Limited.

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We specialise in the most modern and efficient Foundry Plant. Our experience in Continuous Castings Systems will be of great value to you.

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Our technical staff at your service.

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Raw Material Markets

There is little prospect of any immediate relief from the stringency which exists in regard to pig-iron and steel materials. The lack of supplies and the high level of prices of ore and coke make it difficult to increase output. In Scotland, it has been suggested that furnaces which have not been in use for many years might be reconditioned and put into operation, but a considerable time must inevitably elapse before any real benefit could accrue from such a move. Prices will come up for revision in the near future, and an early announcement would be welcomed generally.

Pig-Iron

MIDDLESBROUGH.—Despite offers at enhanced prices from abroad, makers are adhering strictly to their contracts with home consumers. The shortage of raw materials does not allow for the expansion of outputs, and deliveries have fallen further into arrears. Producers and consumers would like to know the amount by which prices will be advanced, when they come up for revision shortly. Meanwhile, No. 3 Cleveland G.M.B. is quoted at 81s., No. 1 foundry 83s. 6d., and No. 4 foundry and No. 4 forge iron 80s. per ton, delivered Middlesbrough. Consumers of hematite are managing to keep their rate of working at a high level, but there is no surplus material available. Export trade has involved small tonnages only. Mixed numbers of East Coast hematite are quoted at 97s. 6d. per ton, delivered to the Middlesbrough area, 103s. in Sheffield, and 108s. 6d. in Birmingham, subject to 5s. per ton rebate.

LANCASHIRE.—It is quite impossible for consumers to obtain their full requirements of pig-iron, and replacement contracts are only for limited supplies. Stocks, where they are available, are being rapidly taken up. For delivery to users in the Lancashire price zone, offers of Staffordshire and Derbyshire brands of No. 3 foundry iron are all on the basis of 89s. per ton, with Northamptonshire at 87s. 6d., and Derbyshire forge iron at from 84s. to 86s., according to the class of consumer. West Coast hematite is quoted at 106s., and East Coast material at 105s. 6d., delivered in the Manchester area, and subject to a rebate of 5s. per ton. Scottish foundry iron is nominal around 106s. Hematite is in very short supply, and few contracts can be negotiated.

MIDLANDS.—Consumers who are in the fortunate position of possessing stocks of pig-iron are able to draw on these supplies, and thus maintain their outputs at full capacity. In most cases, current deliveries are insufficient to permit expansion of output. Controlled prices are unchanged at 83s. 6d. for Northants No. 3 and 86s. for Derbyshire, Lincolnshire and North Staffordshire No. 3. The foregoing quotations include delivery to Birmingham and Black Country stations, and are subject to an extra of 11d. per ton if delivery into works is stipulated. Only small tonnages of special irons are now available on the open market. Low-phosphorus iron is quoted at from £5 10s. to £5 15s., while as much as £6 has been paid. Medium-phosphorus iron is nominal at £5 5s., with refined iron at a minimum of £6 17s. 6d. per ton. Supplies of Scottish iron are practically non-existent. Producers of hematite have no iron to sell before the end of June, and they are not disposed to enter into new business beyond this period. Prices are unaltered at £5 9s. 6d. for West Coast mixed numbers, £5 8s. 6d. for East Coast No. 3 and £5 8s. for Welsh mixed numbers, delivered the Midlands.

SCOTLAND.—It is possible that some old furnaces will be brought into operation in order to relieve the acute shortage of pig-iron. These furnaces, however, would have to be reconditioned, and production would not be possible for a considerable time. No. 1 foundry is still quoted at 90s. 6d. and No. 3 at 88s. per ton, both f.o.t. furnaces. Prices of No. 3 Cleveland are only nominal at 84s. f.o.t. Falkirk, and 87s. f.o.t. Glasgow. The steelworks are finding it difficult to procure adequate supplies of both hematite and basic. Mixed numbers of hematite are quoted at 98s., and British and Indian basic 82s. 6d. per ton, both subject to a rebate of 5s. per ton and delivered f.o.t. steelworks.

Coke

The foundry-coke market remains very firm and there is every prospect of further price movement in the near future. Quotations have been raised considerably recently, but it is doubtful whether they have reached the peak. For delivery to Birmingham and district, best Durham coke is controlled at 46s. 6d., minimum, while Welsh coke is not controlled and is quoted at from 47s. 6d. to 57s. 6d. per ton, according to quality.

Steel

The volume of new business since the holidays has been restricted by the inability of the steel manufacturers to add to their already crowded order-books, states the official report of the London Iron and Steel Exchange. On the other hand, the requirements of the market appear to be increasing, and a large amount of work has been held up by the late delivery and the scarcity of steel materials. The difficulty of obtaining fresh supplies of steel-making pig-iron and scrap are still a serious handicap to the steelmakers in their efforts to maintain outputs; but recently additional purchases have been made abroad which should ease the situation in the near future. The shortage of semi-finished steel has not been relieved and the activity of the consuming industries is being seriously affected. Negotiations are in progress to obtain supplies of foreign material, and it is possible that shortly some of the arrears of the deliveries of Continental steel may be overtaken. In the meantime, the works which have to purchase their semi-finished steel have been obliged in some cases to close down part of their plant. The demand for finished steel is in excess of the supply, and, although the producers are endeavouring to apportion their output among their customers, the shortage is causing delay in the execution of important undertakings. Little export business is possible in these circumstances, and orders from oversea markets have had to be refused by British works.

Scrap

Business continues to be restricted by the lack of information regarding the new selling prices under the control scheme. While deliveries under existing contracts are being made according to schedule, merchants are reluctant to enter into new commitments at the present time. Steelmakers in all districts have expanding requirements, but considerable opposition is being encountered before they are able to purchase additional supplies. The question of prices, however, is not the only deterrent to new trade, as the shortage of many qualities is still very pronounced. Prices are very firm in all parts of the country.

Metals

A quiet tone has prevailed in the non-ferrous metal markets during the past week. To some extent, President Roosevelt's criticism of the rapid advance in prices of durable goods must be held responsible, while Mr. Cordell Hull's speech, in which he declared his profound belief that the statesmen of the world could come together amicably and achieve an "enduring peace," also had a similar effect. The reaction is only considered on the Metal Exchange to be of a temporary nature.

Copper.—Business in this country has been on a small scale, and already there is considerable talk of a substantially lower price for copper. Consumption is expected to continue in heavy volume, but buyers are not likely to exert such pressure as has been the case recently. In the United States, also, business has been quieter, and following the President's statement copper futures broke 25 to 30 points after an earlier decline of 25 points. It was at first thought likely that the statement might result in a more conservative buying policy by domestic consumers at the 17 cents level, but the price has since been reduced to 16 cents per lb.

Metal Exchange quotations were as follow:—

Cash.—Thursday, £71 10s. to £71 12s. 6d.; Friday, £70 to £70 2s. 6d.; Monday, £68 12s. 6d. to £68 17s. 6d.; Tuesday, £67 to £67 2s. 6d.; Wednesday, £63 15s. to £63 17s. 6d.

Three Months.—Thursday, £71 to £71 2s. 6d.; Friday, £69 7s. 6d. to £69 8s. 9d.; Monday, £68 to £68 2s. 6d.; Tuesday, £66 10s. to £66 12s. 6d.; Wednesday, £62 17s. 6d. to £63.

Tin.—Rather less favourable statistics than had been anticipated have resulted from trade during the month of March. Mr. W. H. Gartsen (Henry Rogers, Sons & Company) announces that total visible supplies on March 31 were 19,596 tons, as compared with 18,758 tons on February 28, 1937, and 14,747 tons on March 31, 1936. The carry-over in the Straits Settlements was 2,608 tons, against 2,924 tons and 1,509 tons respectively, while the carry-over at the Arnhem (Holland) smelter was 1,272 tons, against 1,074 tons and 1,080 tons respectively. From these figures it will be seen that the increase in total visible supplies on the month was 720 tons, which is nearly as many tons in excess of what had been expected. The Arnhem tin smelter is to put into operation a fourth furnace. It is understood that this will increase the smelting capacity to 60,000 tons of ore annually, and will be in operation by August of the present year. On Wednesday the price decreased by £11.

Official quotations were as follow:—

Cash.—Thursday, £290 to £290 5s.; Friday, £284 10s. to £285; Monday, £286 to £286 5s.; Tuesday, £283 to £283 5s.; Wednesday, £272 to £273.

Three Months.—Thursday, £287 to £287 5s.; Friday, £281 15s. to £282; Monday, £283 5s. to £283 10s.; Tuesday, £280 5s. to £280 10s.; Wednesday, £270 to £270 5s.

Spelter.—While consumption is well maintained, an easier tone has ruled in this market. The Metallgesellschaft reports that the daily output of spelter throughout the world in January was only 3,968 metric tons, as compared with 4,418 tons in December.

Daily market prices:—

Ordinary.—Thursday, £32 6s. 3d.; Friday, £31 7s. 6d.; Monday, £30 15s.; Tuesday, £30 2s. 6d.; Wednesday, £26.

Lead.—The supply position continues to improve, and, as users generally are well covered, new business is not likely to be very substantial in the immediate future. In the United States, the price has been reduced to 6.90 cents per lb. New York.

Soft Foreign (Prompt).—Thursday, £30 17s. 6d.; Friday, £30 8s. 9d.; Monday, £30 2s. 6d.; Tuesday, £29 1s. 3d.; Wednesday, £25 13s. 9d.

Non-Ferrous Metal Prices

An interesting statement on the position arising out of the recent boom in the non-ferrous metal market is given in the weekly market report issued by Brandeis, Goldschmidt & Company, Limited. The report indicates that fluctuations during the past few weeks have already shown that the rise in metals, and probably most other commodities, has been too quick and overdone. All the same, the firm believes that for some time, maybe years, the level will remain higher than it has been for a long period. If a comparison is made and the year 1913 is taken as the last normal year of business and of general peace, it is found that copper after all is relatively still the cheapest metal. Nevertheless, the price of copper over the next few years may be somewhat—but not much—lower than the present price. The average price of standard copper in 1913 was about £68 per ton, while the highest price in 1937, so far, is about £76 per ton. The corresponding prices of other metals are as follow:—Standard tin, £201 and £300; spelter, £23 and £37; lead, £18 and £36. While copper has risen about 11 per cent., tin has gained about 50 per cent., spelter has gained about 60 per cent., and lead has advanced about 100 per cent. Thus, if £65 is taken as a normal price to-day for copper, tin ought to be £192, spelter £22, and lead £17. The report goes on to point out that the comparisons which are made may be challenged as not being correct, as, in 1913, the world was still on a gold basis, while, since then, inflation has come and almost every country has gone off the gold standard. If gold was taken into account, the firm states the comparison would be even more startling.

Catalogue Received

pH Recorders. The Cambridge Scientific Instrument Company, Limited, of 45, Grosvenor Place, London, S.W.1, have sent us a folder No. 56 which describes and illustrates an outfit for recording p_H values and many plants which have installed it. A typical control chart is centrally attached. Foundries having electroplating departments or using an erratic water supply would do well to familiarise themselves with this apparatus.

For **"easy stripping"** use

YORKSHIRE SAND

Yorkshire Sand is of a synthetic nature, its production being under careful laboratory control. Perfect standardization is obtained with the various grades, suitable for light and the heaviest steel castings.

It is because of the refractoriness of the sand and of the toughness of the mould surface that castings made with Yorkshire Sand are distinguishable by their excellent finish.

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SCOTTISH OFFICE: 48, West Regent Street, Glasgow. Telephone: 3009. Telegrams: "Genefax, Glasgow." (Mr. C. A. G. Thomson.)

MANCHESTER OFFICE: 9, Albert Square, Manchester, 2. Telephone: Blackfriars 6130. Telegrams: "Genefax, Manchester." (Mr. S. G. Throssell.)

SWANSEA OFFICE: Metropole Chambers, Wind Street, Swansea. Telephone: 3680. Telegrams: "Genefax, Swansea." (Mr. D. Hood-Williams.)

CARDIFF OFFICE: 17, Windsor Place, Cardiff. Telephone: 5796. Telegrams: "Genefax, Cardiff." (Mr. F. E. Rutter.)

MIDDLESBROUGH OFFICE: Halifax Buildings, Exchange Place.
Telephone: Middlesbrough 3313. Telegrams: "Genefax, Middlesbrough." (Mr. C. Souness.)

★

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"During the 40 years I have been connected with Steel Foundry work, considerable changes have taken place. Away back, we had Steel Moulders' Composition, Old Crucible Pots, etc., and each works claimed to have its own 'secret' moulding composition. High Silica Sand has eliminated practically all these from many foundries and to-day we have your 'Yorkshire Sand' which acts almost like a chill, and leaves the skin of the casting blue-black and as clean as cast iron.

The hot steel lies quietly against the wall of sand, and often when the casting has been lifted out of the mould, the latter looks as if it could be used over again, just like a permanent mould."

RAW MATERIALS—PRICE LIST

(Wednesday, April 7, 1937)

COPPER

	£	s.	d.
Standard cash	63	15	0
Three months	62	17	6
Electrolytic	67	0	0
Tough	67	10	0
Best selected	68	0	0
Sheets	100	15	0
India	78	15	0
Wire bars	69	5	0
Ingot bars	69	5	0
H.C. wire rods	72	15	0
Off. av. cash, Mar.	72	8	11¼
Do., 3 mths., Mar.	71	1	5½
Do., Sttlmnt., Mar.	72	7	11½
Do., Electro, Mar.	77	18	6½
Do., B.S., Mar.	77	5	3½
Do., wire bars, Mar.	77	18	6½
Solid drawn tubes			15¼d.
Brazed tubes			15¼d.
Wire			11¼d.

BRASS

Solid drawn tubes	13½d.
Brazed tubes	15½d.
Rods, drawn	12d.
Rods, extd. or rlld.	8½d.
Sheets to 10 w.g.	11½d.
Wire	11d.
Rolled metal	11d.
Yellow metal rods	8½d.

TIN

	£	s.	d.
Standard cash	272	0	0
Three months	270	0	0
English	272	10	0
Bars	274	0	0
Straits	273	0	0
Australian		—	
Eastern	271	10	0
Banca	273	10	0
Off. av. cash, Mar.	283	5	7½
Do., 3 mths., Mar.	278	19	6½
Do., Sttlmt., Mar.	283	4	0½

SPELTER

	£	s.	d.
Ordinary	26	0	0
Remelted	25	15	0
Hard	23	0	0
Electro 99.9	28	12	6
English	27	7	6
India	24	5	0
Zinc dust	30	0	0
Zinc ashes	11	0	0
Off. aver., Mar.	33	5	11 1/12
Aver. spot, Mar.	33	3	9

LEAD

	£	s.	d.
Soft foreign, ppt.	25	13	9
Empire (nom.)	29	16	3
English	27	15	0
Off. aver., Mar.	33	0	0½
Aver. spot, Mar.	33	0	6½

ALUMINIUM

Ingots	£100 to £105
Wire	1/3 to 1/4 lb.
Sheet and foil	1/2 to 1/4 lb.

ZINC SHEETS, &c.

Zinc sheets, English	45	5	0 to 45	15	0
Do., V.M. ex-whse.	45	5	0 to 45	15	0
Rods			46	0	0

ANTIMONY

English	88	0	0 to 89	0	0
Chinese, ex-whse.			76	10	0
Crude, c.i.f.			43	0	0

QUICKSILVER

Quicksilver	14	7	3

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—						
25%				10	15	0
45/50%	10	15	0 to	12	0	0
75%	15	15	0 to	17	0	0
Ferro-vanadium—						
35/50%				12/8 lb. Va		
Ferro-molybdenum—						
70/75% carbon-free				4/9 lb. Mo.		
Ferro-titanium—						
20/25% carbon-free				9d. lb.		
Ferro-phosphorus, 20/25%				£21 to £22		
Ferro-tungsten—						
80/85%				.5/- lb. (nom.)		
Tungsten metal powder—						
98/99%				.5/3 lb. (nom.)		
Ferro-chrome—						
2/4% car.				31	17	6
4/6% car.				21	10	0
6/8% car.				21	0	0
8/10% car.				21	0	0
Ferro-chrome—						
Max. 2% car.				32	10	0
Max. 1% car.				35	15	0
Max. 0.5% car.				36	10	0
70% carbon-free				9½d. lb.		
Nickel—99.5/100%				£180 to £185		
"F" nickel shot				£165	0	0
Ferro-cobalt, 98/99%				7/3 lb.		
Metallic chromium—						
96/98%				2/5 lb.		
Ferro-manganese—						
76/80% loose	£13	15	0 to 14	5	0	
76/80% packed	£14	15	0 to 15	5	0	
76/80% export			£13	0	0	
Metallic manganese—						
94/96% carbon-free				1/3 lb.		

Per ton unless otherwise stated, basis 2-ton lots.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten 2s. 2d.
Finished bars, 18% tungsten 3s. 0d.
Per lb. net, d/d buyers' works.

Extras—
Rounds and squares, 3 in. and over 4d. lb.
Rounds and squares, under ½ in. to ¼ in. 3d. lb.
Do., under ¼ in. to 3/16 in. 1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ¼ in. 3d. lb.
Do., under ½ in. × ¼ in. 1/- lb.
Bevels of approved sizes and sections 6d. lb.
Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	3	8	0 to	3	10	0
Mixed iron and steel	3	5	0 to	3	7	6
Heavy cast iron	3	8	0 to	3	10	0
Good machinery	4	0	0 to	4	5	0
Cleveland—						
Heavy steel				3	7	0
Steel turnings				2	12	6
Heavy cast iron				4	2	6
Heavy machinery				4	5	0
Midlands—						
Short heavy steel	3	12	6 to	3	15	0
Light cast-iron scrap				3	5	0
Heavy wrought iron	3	17	6 to	4	2	6
Steel turnings				2	5	0
Scotland—						
Heavy steel	3	4	6 to	3	7	0
Ordinary cast iron				4	2	6
Cast-iron borings	2	0	0 to	2	2	6
Wrot-iron piling				4	2	6
Heavy machinery				4	7	6

London—Merchants' buying prices, delivered yard.

Copper (clean)	56	0	0
Brass	35	0	0
Lead (less usual draft)	25	10	0
Tea lead	22	0	0
Zinc	18	0	0
New aluminium cuttings	75	0	0
Braziery copper	52	0	0
Gunmetal	56	0	0
Hollow pewter	190	0	0
Shaped black pewter	138	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—

Foundry No. 1	83/6
,, No. 3	81/-
,, No. 4	80/-
Forge No. 4	80/-
Hematite No. 1	98/-*
Hematite M/Nos.	97/6*
N.W. Coast—	
Hem. M/Nos. d/d Glas.	98/-*
,, d/d Birm.	109/6*
Malleable iron d/d Birm.	135/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	83/-
,, No. 3 fdry.	86/-
Northants forge	80/6
,, fdry. No. 3	83/6
,, fdry. No. 1	86/6
Derbyshire forge	83/-
,, fdry. No. 3	86/-
,, fdry. No. 1	89/-
Scotland—	
Foundry, No. 1, f.o.t.	90/6
,, No. 3, f.o.t.	88/-
Cleveland No. 3, Glasgow	87/-
,, ,, Falkirk	84/-
Scottish hem. M/Nos. d/d	98/-*
Sheffield (d/d district)—	
Derby forge	80/6
,, fdry. No. 3	83/6
Lincs forge	80/6
,, fdry. No. 3	83/6
W.C. hematite	103/6*
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	89/-
Staffs fdry. No. 3	89/-
Northants fdry. No. 3	87/6
Cleveland fdry. No. 3	89/-
Glengarnock, No. 3	106/-
Clyde, No. 3	106/-
Monkland, No. 3	106/-
Summerlee, No. 3	106/-
Eglinton, No. 3	106/-
Gartsherrie, No. 3	106/-
Shotts, No. 3	106/-

* Subject to a rebate of 5s. per ton under certain conditions.

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

	£	s.	d.	£	s.	d.
Iron—						
Bars (cr.)				11	17	6
Nut and bolt iron	10	5	0 to	10	15	0
Hoops				12	15	0
Marked bars (Staffs) f.o.t.				14	7	6
Gas strip				12	15	0
Bolts and nuts, ¼ in. × 4 in.				17	10	0 and up.
Steel—						
Plates, ship, etc.	9	10	6 to	9	13	0
Boiler plts	10	0	6 to	10	3	0
Chequer plts.				11	3	0
Angles				9	3	0
Tees				10	3	0
Joists				9	3	0
Rounds and squares, 3 in. to 5½ in.				10	3	0
Rounds under 3 in. to ½ in. (Untested)				9	10	0
Flats—8 in. wide and over				9	8	0
,, under 8 in. and over 5 in.				9	13	0
Rails, heavy	8	5	0 to	8	10	0
Fishplates				12	10	0
Hoops (Staffs)				10	5	0
Black sheets, 24g. (4-t. lots)				14	0	0
Galv. cor. shts. (,,)				17	0	0
Galv. flat shts. (,,)				17	10	0
Galv. fencing wire, 8g. plain				16	0	0
Billets, soft				6	5	0
Sheet bars	6	2	6 to	6	10	0
Tin bars	6	2	6 to	6	10	0

PHOSPHOR BRONZE

	Per lb. basis
Strip	14½d.
Sheet to 10 w.g.	15½d.
Wire	16½d.
Rods	16½d.
Tubes	21½d.
Castings	16d.

Delivery 3 cwt. free.
10% phos. cop. £33 above B.S.
15% phos. cop £38 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. Clifford & Son, Limited.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	10d. to 1/4
Rolled—	
To 9 in. wide	1/4 to 1/10
To 12 in. wide	1/4½ to 1/10½
To 15 in. wide	1/4½ to 1/10½
To 18 in. wide	1/5 to 1/11
To 21 in. wide	1/5½ to 1/11½
To 25 in. wide	1/6 to 2/-
Ingots for spoons and forks	10d. to 1/6½
Ingots rolled to spoon size	1/1 to 1/9½
Wire round—	
to 10g.	1/7½ to 2/2½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/6½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	25.76
No. 2 foundry, Valley	24.00
No. 2 foundry, Birm.	20.38
Basic, Valley	23.50
Malleable, Valley	24.00
Grey forge, Valley	20.50
Ferro-mang. 80%, seaboard	80.00
O.-h. rails, h'y, at mill	42.50
Billets	37.00
Sheet bars	37.00
Wire rods	47.00
	Cents.
Iron bars, Chicago	—
Steel bars	2.45
Tank plates	2.25
Beams, etc.	2.15
Skelp, grooved steel	2.10
Steel hoops	2.10
Sheets, black, No. 24	2.40
Sheets, galv., No. 24	3.80
Wire nails	2.75
Plain wire	2.90
Barbed wire, galv.	3.40
Tinplates, 100-lb box	$4.85

COKE (at ovens)

Welsh foundry	32/6 to 33/-
,, furnace	27/- to 28/-
Durham foundry	28/-
,, furnace	27/-
Scotland foundry	28/-
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	24/- to 25/-	
,,	28×20 ,,	48/- to 50/-	
,,	20×10 ,,	31/- to 32/-	
,,	18¾×14 ,,	24/6 to 25/6	
C.W.	20×14 ,,	21/- to 22/-	
,,	28×20 ,,	42/- to 43/-	
,,	20×10 ,,	26/- to 27/-	
,,	18¾×14 ,,	21/6 to 22/6	

SWEDISH CHARCOAL IRON & STEEL

Pig-iron	£12	0	0 to	£13	0	0
Bars-hammered, basis	£18	10	0 to	£20	0	0
Bars and nail-rods, rolled, basis	£17	10	0 to	£18	10	0
Blooms	£14	0	0 to	£14	10	0
Keg steel	£26	0	0 to	£29	0	0
Faggot steel	£19	0	0 to	£25	0	0
Bars and rods dead soft, st'.	£16	0	0 to	£18	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 19.39 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.		
Apr.	1 ..	71	10	0	dec.	27/6
,,	2 ..	70	0	0	,,	30/–
,,	5 ..	68	12	6	,,	27/6
,,	6 ..	67	0	0	,,	32/6
,,	7 ..	63	15	0	,,	65/–

Electrolytic Copper

		£	s.	d		
Apr.	1 ..	76	0	0	dec.	40/–
,,	2 ..	73	0	0	,,	60/–
,,	5 ..	72	10	0	,,	10/–
,,	6 ..	70	0	0	,,	50/–
,,	7 ..	67	0	0	,,	60/–

Standard Tin (cash)

		£	s.	d.		
Apr.	1 ..	290	0	0	dec.	80/–
,,	2 ..	284	10	0	,,	110/–
,,	5 ..	286	0	0	inc.	30/–
,,	6 ..	283	0	0	dec.	60/–
,,	7 ..	272	0	0	,,	220/–

Tin (English ingots)

		£	s.	d.		
Apr.	1 ..	290	5	0	dec.	90/–
,,	2 ..	284	10	0	,,	115/–
,,	5 ..	286	0	0	inc.	30/–
,,	6 ..	283	0	0	dec.	60/–
,,	7 ..	272	10	0	,,	210/–

Spelter (ordinary)

		£	s.	d.		
Apr.	1 ..	32	6	3	dec.	26/3
,,	2 ..	31	7	6	,,	18/9
,,	5 ..	30	15	0	,,	12/6
,,	6 ..	30	2	6	,,	12/6
,,	7 ..	26	0	0	,,	82/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
Apr.	1 ..	35	0	0	dec.	23/9
,,	2 ..	34	0	0	,,	20/–
,,	5 ..	33	7	6	,,	12/6
,,	6 ..	32	15	0	,,	12/6
,,	7 ..	28	12	6	,,	82/6

Lead (soft foreign, prompt)

		£	s.	d.		
Apr.	1 ..	30	17	6	dec.	18/9
,,	2 ..	30	8	9	,,	8/9
,,	5 ..	30	2	6	,,	6/3
,,	6 ..	29	1	3	,,	21/3
,,	7 ..	25	13	9	,,	67/6

Lead (English)

		£	s.	d.		
Apr.	1 ..	33	0	0	dec.	15/–
,,	2 ..	32	10	0	,,	10/–
,,	5 ..	32	0	0	,,	10/–
,,	6 ..	31	0	0	,,	20/–
,,	7 ..	27	15	0	,,	65/–

AVERAGE MONTHLY PRICES OF FURNACE COKE D/D MIDDLESBROUGH

Year.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Yearly average.
	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.
1905	0 14 9	0 15 3	0 15 3	0 15 3	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 6	0 15 9	0 17 0	0 15 5½
1906	0 17 6	0 17 6	0 17 0	0 17 0	0 17 0	0 16 6	0 17 0	0 17 0	0 18 3	0 18 6	0 19 0	1 0 0	0 17 8½
1907	1 4 6	1 5 0	1 5 0	1 0 6	1 2 0	1 1 0	1 1 0	1 1 0	1 2 0	1 1 6	1 0 0	0 17 0	1 1 8½
1908	0 16 0	0 16 0	0 15 6	0 16 0	0 16 3	0 16 0	0 15 6	0 15 6	0 15 6	0 15 3	0 16 0	0 16 0	0 15 9½
1909	0 16 0	0 15 3	0 15 0	0 14 9	0 15 6	0 15 9	0 15 6	0 15 6	0 16 6	0 17 0	0 17 6	0 17 0	0 15 11½
1910	0 18 4½	0 18 6½	0 18 0	0 18 0	0 17 10½	0 17 0	0 16 1½	0 15 9½	0 15 11	0 16 0	0 15 9½	0 15 8	0 16 11
1911	0 16 0	0 15 10½	0 15 6	0 15 3	0 14 9	0 14 6	0 14 6	0 14 6	0 14 6	0 14 11½	0 15 0½	0 16 3½	0 15 1½
1912	0 17 3	0 17 3	0 18 6	0 18 10	0 19 0	0 19 4½	0 19 10½	1 0 9½	1 2 9	1 4 1½	1 5 8½	1 8 6	1 1 0
1913	1 5 9	1 4 11	1 5 0	1 5 0	1 4 9½	1 0 4½	0 19 5½	0 18 3	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1914	0 18 2	0 17 1	0 17 0	0 17 0	0 17 4	0 17 6	0 17 6	0 18 5	0 18 5	0 18 4	0 17 9	0 17 6	0 18 5	0 17 8
1915	0 17 10½	0 17 9	1 0 4½	1 7 7½	1 9 4½	1 10 7½	1 9 7	1 7 3	1 5 4	1 4 9	1 9 6	1 13 0	1 6 1
1916	1 10 9	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6½
1917	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 10 6	1 14 3	1 11 2½
1918	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6	1 15 6
1919	1 15 6	1 15 6	1 15 6	1 15 6	2 1 6	2 1 6	2 3 9	2 10 6	2 10 6	2 10 6	2 10 6	2 10 6	2 3 5
1920	2 12 3	2 14 0	2 19 0	2 19 0	3 3 8	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 6 0	3 2 6
1921	3 1 0½	2 19 0	2 16 0	2 7 0	2 6 6	2 6 6	2 0 6	2 0 0	1 13 11	1 12 9	1 10 4½	1 8 3	2 3 6½
1922	1 7 0½	1 8 1½	1 9 7½	1 8 4½	1 7 11½	1 7 3	1 6 9½	1 6 10½	1 7 0½	1 10 2½	1 10 0	1 9 11½	1 8 3½
1923	1 11 3	1 14 6	2 0 1½	2 2 8½	2 4 4½	2 2 10½	2 1 0½	2 1 6	2 0 9½	1 18 9	1 18 8½	1 18 3	1 19 7½
1924	1 16 6½	1 14 9	1 11 11½	1 10 0½	1 8 1½	1 7 8½	1 7 3	1 6 3	1 6 0	1 5 0	1 5 0	1 5 0	1 9 5½
1925	1 4 10½	1 4 1½	1 13 3	1 2 4½	1 2 2½	1 1 5½	1 1 3½	1 4 9	0 18 10½	0 18 4½	0 19 6½	1 1 4½	1 2 8½
1926	1 2 1½	1 0 9	0 19 2½	0 18 6½	*	*	*	*	*	*	*	1 5 0	1 1 ‖
1927	1 5 6	1 4 9½	1 6 1½	1 3 9	1 2 6	1 0 8½	0 19 4½	0 19 0	0 18 7½	0 18 0	0 17 10½	0 17 6	1 1 1½
1928	0 17 6	0 17 10½	0 18 0½	0 17 11½	0 17 8½	0 17 6½	0 17 7½	0 17 6½	0 17 6	0 17 7½	0 17 7½	0 17 6	0 17 8
1929	0 17 7½	0 18 0	0 19 0	0 19 6½	0 18 10½	0 19 10½	1 1 3½	1 1 8½	1 3 0	1 3 6	1 3 8	1 3 1½	1 0 9½
1930	1 2 0½	1 1 3	1 0 3	0 19 1½	0 17 7	0 16 10½	0 16 6	0 16 6	0 16 9	0 17 0	0 17 0	0 17 0	0 18 2½
1931	0 17 0	0 16 7½	0 16 0	0 16 0	0 15 11	0 15 5	0 15 1	0 15 0	0 15 0	0 16 9	0 17 0	0 17 0	0 16 0½
1932	0 17 0	0 16 11½	0 16 5½	0 15 9	0 15 7½	0 15 6	0 15 6	0 14 9½	0 14 6½	0 14 6	0 14 6	0 15 4	0 15 6½
1933	0 16 0½	0 15 11½	0 15 6½	0 15 6	0 15 6	0 15 6	0 15 6	0 15 8½	0 16 1½	0 17 0	0 17 6	0 18 0	0 16 1½
1934	0 19 1½	1 0 6	1 0 2	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	1 0 0	0 19 11½
1935	1 0 0	0 19 6½	0 19 0½	0 19 0	0 19 0	0 19 0	0 19 0	0 19 0	0 18 9½	0 18 9½	0 19 3½	1 1 2½	0 19 2½
1936	1 2 0	1 2 11½	1 3 2½	1 4 0	1 4 11½	1 4 3½	1 5 1	1 4 7½	1 4 6	1 4 6	1 4 6	1 4 6	1 4 1
1937	1 5 3½	1 5 10½	1 7 7½	—	—	—	—	—	—	—	—	—	—

* Strike period. ‖ Five months.

WILLIAM JACKS & COMPANY,

WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.

13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,

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ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

CUPOLA-FURNACEMAN, experienced and reliable, desires situation. Reference.—Box 318, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

FOUNDRY FOREMAN desires change; 35. Sound practical and technical experience, jobbing or repetition; continuous plant experience. Excellent references.—Box 328, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WANTED.—Man fully experienced in Machine Moulding to take complete charge of several moulding machines in foundry in North of England. Apply stating experience and salary wanted to: Box 324, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKS MANAGER for large Grey Iron Foundry in Midlands specialising in repetition castings and cylinders; experienced in machine moulding and good organiser. State full experience, age, salary required.—Box 322, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

WORKS MANAGER required for an old-established and important Roll Foundry. Must be thoroughly experienced in the manufacture of chilled, grain and alloy rolls, and a good works and foundry organiser. Substantial salary to the right man. Apply, stating full details of experience, which would be treated in strict confidence, to: Box 326, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PATENT

THE proprietors of British Patent No. 404,471, for "Improvements in and relating to the production of Corrosion-resistant Iron Alloys," are desirous of entering into negotiations with interested parties for the granting of licences thereunder on reasonable terms, or for the sale of the patent outright. All inquiries should be addressed to: Box 320, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

PROPERTY

MODERN Steelfoundry at Rotherham, main building 65 ft. by 150 ft. (erected 1916); complete with 10-ton crane. Site 1 acre. Siding on L.N.E. Rly. Adjacent canal.—Apply: GORDON, P.O. Box 98, Sheffield.

MACHINERY

FOUNDRY PLANT WANTED.—Several good Foundry Crane Ladles.
Cupola about 4 ft. 6 in. diameter.
Denison Crane Weighers from 1 to 10 tons capacity.
Swing frame Grinder, portable type, complete with motor.

A. HAMMOND,
14, Australia Road, Slough.

SAND MIXERS AND AERATORS.—The "Breakir" Centrifugal Machine is *THE* machine. Outputs 10 cwts. to 8 tons per hr.—W. BREALEY & Co., LTD., Station Works, Ecclesfield, Sheffield.

MACHINERY—*Continued*

'Phone 98 Staines.

VERTICAL Boiler, 8 ft. 8 in. by 4 ft., 80 lbs. w.p.
8-in. Roots Blower, as new, 5 lbs. pressure.
Horizontal Compressor, steam driven, 8 in. and 8½ in. by 9 in.
Air Receiver, 11 ft. 6 in. by 2 ft. 6 in
Air Receiver, 20 ft. by 3 ft.

HARRY H. GARDAM & CO., LTD.,
STAINES.

NEW Dwarf Cupola, to melt 10 to 15 cwts. per hr. New Worm-geared Ladles, 5 tons, 25 cwts., 15 cwts. and 10 cwts. capacity. Ungeared Ladles, 15 cwts. and 10 cwts. capacity. Improved Cupola Spark Arresters.—T. DAVIES & SON, West Gorton, Manchester.

ELECTRIC CUPOLA BLOWERS (large stock), including two 50-h.p. 3/50/400 volts, 2,900 r.p.m.; Keith Blackman; 12-in. outlet.
30-h.p. ditto; 12-in. outlet.
5-h.p. ditto; 6-in. outlet.
20-h.p. 460 volts d.c., 2,400/1,900 r.p.m.; 10-in. outlet.
EXHAUST FANS (large stock), electrical and belt driven.
ELECTRIC RUNWAY LIFTING BLOCKS:
One 4½-ton 460 volts d.c., Vaughan.
Two 2-ton ditto, Morris.
One ½-ton 220 volts d.c., Morris (as new).
One ½-ton 3/50/440 volts, Aabacas.
Two Reavell Rotary Compressors, 12 lbs. sq. in. pressure; 750 cub. ft. direct-coupled on bedplate to 60 h.p. S.R., 3/50/400 volts motor.
½-cwt. Pilkington Self-contained Pneumatic Hammer.
Geared Foundry Ladles, 9, 4, 3½, 2½ and 1 ton, etc.
AIR COMPRESSORS: 30 in stock in sizes 500 to 20 cub. ft.
ELECTRIC MOTORS: Large stock to suit almost all electric systems.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

THOS. W. WARD LTD.

FOR ECONOMY — EFFICIENCY — GENERAL UTILITY.
"FORWARD" FOUNDRY SAND RIDDLE.
Capacity approximately 5 tons of foundry sand per hr. Self-contained. Drive from ½-h.p. totally-enclosed Motor. All working parts fitted Ball Bearings; provided with dust guards. 22" dia. Sieve can be removed and replaced instantly. Tubular Tripod with shoes.
Price, with A.C. or D.C. Motor, standard voltage, £25 10s.

Write for "Albion" Catalogue.

'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

MISCELLANEOUS

GENUINE Southport Wind Blown Sand, which makes best oil-sand cores. Prompt deliveries by road into works.

JOHN LIVESEY,
SAND MERCHANT,
SOUTHPORT.

PATTERNS IN WOOD AND METAL for all branches of Engineering. Moulding methods carefully considered.—FURMSTON & LAWLOR, Letchworth.

FINEST FOUNDRY BLACKINGS AND FACINGS. All our own productions by the latest machinery. Pure Ceylon Plumbago (import direct). Quality at reasonable prices. Orders are repeated Send for free sample.

JOHN & C. DURRANS,
PENNINE WORKS,
HAZLEHEAD, NEAR SHEFFIELD.
Telephone: 128 Penistone. Telegrams: "Facings, Penistone."

MISCELLANEOUS—*Continued*

SAND.—Hill and Sea Sand delivered by road or rail at your works. Write for prices.—THOMAS BALL & SONS, C.L.C. Goods Station, Southport.

STRAW ROPES for core and packing purposes. Sizes ¼ in. to 1½ in. dia. We quote by weight as well as by measure. Important—We are the only local makers of this article.—WILLIAM OLSEN, LTD., Hull.

'Phone: 287 SLOUGH

SEVERAL Good Foundry Grinders, Price, £5 to £20.

12' square Sand Blast Room Plant complete and in good condition. Price, £180.

Four Morgan Oil-fired Tilting Furnaces reconditioned — 450-lbs. capacity. Also 250-lbs. and 600-lbs. capacity in stock. CHEAP.

Large stock of Moulding Machines, Compressors and A.C. Motors.

PLEASE SEND US YOUR ENQUIRIES.

ALEX. HAMMOND, *Foundry Machinery Merchant.*
14, AUSTRALIA ROAD, SLOUGH
BUY FROM ME AND SAVE MONEY!

THE RAPID MAGNETTING MACHINE Co. Ltd.
MAGNET WORKS, LOMBARD ST. BIRMINGHAM, 12

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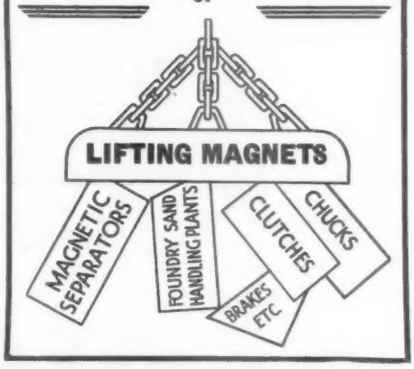

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